ORGANIZATION OF INVESTIGATION IN AGRICULTURE[1]

E. W. ALLEN

Chief, Office of Experiment Stations, United States Department of Agriculture, Washington, D. C.

The organization of investigation with a view to a larger measure of coöperation among institutions and workers, and greater attempt toward coördination, is at present perhaps the livest subject connected with scientific research. Hardly an address is delivered which does not touch upon this subject, and very many in the past year have dealt primarily with it. The idea is not new, as the work of this Association testifies, but it has been given new force and far broader scope in the past few years.

This association is well-nigh a pioneer in that field, and the systematic study it has devoted to the details and means of accomplishing the ends sought has made it one of the going agencies in this line. There is something stimulating in knowing that the idea the Association has stood for is gaining ground, and we may feel a new conviction that in this effort we are on the right track and in the line of progress. It may be interesting to reflect briefly on the recent growth of efforts in this field.

The war gave a great impetus to coöperative effort in all directions, including agriculture. It developed the National Research Council, which is founded in the idea of coöperative and coördinated effort. It gave so many illustrations of usefulness that the Council has been made permanent, and is now organized on a generous plan which embraces a division for the biological sciences and agriculture. The prime purpose of the Council is to afford opportunity for coöperation and to assist in bringing it about, without itself having part in the investigations. It aims to serve as a stimulating agency, rather than

[1] Read at the Atlanta meeting of the Association of Southern Agricultural Workers, February 26, 1920.

to build up within itself means for carrying on research or for subsidizing it. It does not purpose to centralize the administration of research but to popularize it, to direct attention to the need for it, and to democratize efforts at organization for specific lines of inquiry. As you have seen, the Council has recently received from the Carnegie Corporation a gift of $5,000,000, one million of which is to be used for erecting a building in Washington as a permanent headquarters of the Council and the home of the National Academy of Sciences.

The divisions of the Council embrace many committees. One of these on nutrition is to consider problems in the field of animal as well as human nutrition, and another relating to fertilizers and soils has recently undertaken to catalogue, with the aid of the Office of Experiment Stations, all the projects bearing on this field which are now under way at the experiment stations, in the Department of Agriculture, and at other institutions in this country. Such a classified list of live undertakings may serve as a basis for coöperative or coördinated attack, and it may later furnish the means for a thorough digestion of the investigation in particular lines, in order to determine what may be accepted as established and what next steps are indicated. The work of the National Research Council bears, therefore, on that of this Association, and it seems not improbable that to an extent the two may join hands.

The Association of Land-Grant Colleges has, as you know, taken a definite stand in favor of coöperation and proposed the formation of a joint committee with the Department of Agriculture, to be known as an agricultural research council. As yet but little progress has been made in consummating the idea, but the step is a most interesting one as evidencing the present attitude of experiment station workers. Various other organizations, such as the botanists, pathologists, agronomists and the chemists, are committed to the idea of encouraging organized research.

That coöperation in research of various types and grades is feasible and practical there is increasing evidence, drawn from experience in lines where it has been going on. Dr. Hale, of

the National Research Council, has called attention to a number of notable examples in astronomy, physics, engineering, geology, and chemistry. In the study of sediments and sedimentary deposits, for example, the geologist must have the help of the chemist; and, as Dr. Hale points out, "it is easy to see how an investigator choosing to deal with some aspect of this large, general problem would be assisted by information regarding related work planned or in progress, and how readily as a member of the group he could render his own researches more widely useful and significant." In connection with one of the undertakings referred to, Dr. Hale mentions that certain specifications were formulated but those who took part were not bound by any rigid rules. On the contrary, as he says, "they were encouraged to make every possible innovation in the manner of attack in order that obscure sources of error might be discovered and the highest possible accuracy in the final results obtained. The outcome demonstrates most conclusively that organized effort and freedom of initiative are by no means incompatible."

The organization of investigation logically begins with the individual station. To a considerable extent the present policy and program are largely an accumulation of the past. Hence changes may be brought about only slowly. The war led to a review of station projects and the stressing of certain ones of special importance. In a number of cases this has had a permanent effect and resulted in a revision of the entire station program. I have been much impressed with the systematic attempts at several stations to develop a program of work which would be not only more live but more definitely adapted to the special problems and needs of their localities. For example, one station appointed a committee on projects to review the whole list, ascertain the status of each project, the time it had been going, the progress it was making, its prospects and importance, and the work necessary for its completion. This committee under the supervision of the director made a catalog showing for each project the publications issued upon it, its relation to other work of the station, its adequacy, and the future plans of the leader. The latter appeared before the committee and discussed his

projects, explained their importance, and in the end recommended what ones should be continued and what should be brought to a close as soon as feasible.

The advantage of such a review must be apparent. Each project stood on its own merits. Some which had been drifting but had been using up money were detected, and their future decided. In this way a conservative and safe means was provided of sifting out the less active or important as soon as practicable, and a basis furnished for a live, active project list. You will recognize that it furnished the best possible means for establishing coöperation and coördination within and without the station.

At another station a research committee was appointed to revise the project list in much the manner referred to above, but in addition to construct a program of station work designed to better cover matters of prime importance and less dependent on chance or special preference. To this end the heads of departments, extension specialists, and county agents of the state will canvass the needs for investigation, and the suggestions presented will be weighed and incorporated in an adequate constructive program of investigation. Other stations have taken similar steps, but there are indications that the practice might well be more general.

Most stations have too many projects. They are to some extent accumulations, and represent a desire of individual workers to have a considerable list of undertakings. To this extent they embody a false idea, an ambition not in accord with the present views of investigation. It is desirable to encourage narrowing the scope in many cases, and organizing the work so that it will be more definitely centered on specific questions of limited range. The very fact that stations have forty, fifty, and even a hundred projects shows how widely their efforts are being scattered, how far they fail of concentration.

How many projects did Hellriegel have when he set about settling once for all the long contested question of whether legumes take nitrogen from the air? The famous Rothamsted station has always limited its efforts quite definitely. It has

concentrated on special questions, and has broadened its field of investigation almost entirely as a result of questions which the progress of these studies developed. Hilgard concentrated the work of his station on soils and their utilization, expanding his program only gradually as new funds came. One of the chief reasons why Hopkins met with such success in his studies was that, although they covered a quite wide range, they were definitely and consciously centered in his purpose to develop principles of soil fertility and permanent agriculture.

The specialist with only two or three projects may accomplish more for his own reputation and for the permanent benefit of practical agriculture than one who is attempting to carry a dozen or twenty, as some unfortunately are. It is an aid to the man with a long list of projects to have this list reviewed by others in a sympathetic but critical manner, and account of stock taken. It helps him to discard or terminate those he may have been doubtful about, and to direct his efforts along more constructive channels.

Such a scrutiny provides not only against a scattering of effort but against superficial, intermittent work. It may even affect the composition of the staff itself. Station staffs have been made up in the past largely on the basis of departments instead of problems. The reason for this is clear and need not be elaborated; stations have often had to make the best of the material at hand. But with a larger number of persons now assigned primarily to research, the special needs of the station and the lines it plans to study may well figure in the search for a worker and the assignment of duties. In other words, men may be sought to do definite things.

Too often a botanist or a chemist or an animal husbandman has been brought into the staff because there was a vacancy, and then asked to outline some projects, and perhaps told that as he was to be paid partly from the Adams fund he must get one or two lines that would fit that fund. More rarely perhaps is he advised of the station's program and invited to take hold of some phases of problems included in this program, to occupy at least a part of his time. How different is the case with an

industrial concern which opens research laboratories! The latter has certain problems to be worked out and is on the lookout for others in its field which are likely to prove profitable.

Such a selection of men to carry forward predetermined lines is entirely feasible in the case of station forces. When the director of the Maine Station went in search of a biologist he had a very definite purpose in view, and although the man he selected had never worked in that particular line and was not familiar with poultry raising, he was thoroughly trained, and he adapted himself to the situation, developing a department of research of national reputation. There are, of course, many similar illustrations which go to reinforce the feasibility of the station itself making and shaping the general plan of operations, and giving it direction, instead of leaving it to the various departments working independently, or making it contingent on the individual ability of the teaching staff.

It is becoming clearer with the development of station work that in large measure it should be organized around problems. In this the relations of the various departments need to be considered. Broad questions will often involve coöperation, or a division of the inquiry between departments. This may mean either a close working together, or an approach from different standpoints, or the taking up of separate but essential phases of the question. It may even involve one department working for another or under its direction for the time being.

In the drift toward specialization, scientific men have more and more segregated themselves into groups each of which confines itself to the study of a special and often narrow field. Specialization represents a great advance. It recognizes the deeper insight, the necessity of intensive study, and a differentiation of field and of skill. But specialization is opposed to generalization and may unfit men for it.

While specialization has served greatly to advance scientific knowledge, there is a danger in its isolation of retarding the solution of complex problems like those in agriculture. These problems have often been worked upon from the standpoint of the individual specialist, without particular reference to what

investigators in another branch are doing. From the standpoint of the individual a special phase and not the broad problem may become the unit. It does not necessarily require a specialist to see a problem, and he may not see it in its entirety. The analysis of a question is an important step toward its study, and such analysis often needs the combined insight of specialists in different fields. Hence the advantage of organization of research around problems in such a way as to unite this viewpoint and means of attack.

Some men are more resourceful in planning and conducting investigation than others. There are some who are natural leaders, and others who do their best work in association. It is the business of the director to determine this and to use his force and facilities to the best possible advantage. It is one of his functions to study the workers and their work, to determine whether the latter is progressing as it should, to ascertain its needs if there are weak points, and to provide help from another department where it is required. He should form a judgment of the members of his staff, and until he has that there is little warrant for authorizing large undertakings. We ought to avoid experimenting with men as far as possible.

Economy of the supply of workers, and especially those of outstanding ability in research, suggests utilization of their talents to the utmost. Research is not alone for the few if proper guidance can be supplied. Leadership is of great importance to make most highly effective the work of the rank and file. The history of science shows to how large an extent discoveries and important deductions have rested upon long series of accurate observations requiring care and patience, but not necessarily great genius. "The method of science is not a mysterious gift of genius but a practical tool in the discovery of facts and their application to the problems of everyday life." Much credit, therefore, belongs to the patient workers whose efforts help to make discovery possible provided their work is so done that it can be knit together.

A man's inherent right to work independently depends first on his ability and his particular problems, and second on the

requirements of the station program. Such right may never mean freedom from supervision or direction. It should not be forgotten that the workers in an experiment station are members of an organization, bound together by a common interest and purpose, and subject in the final analysis to the general plan of a public service institution. This does not imply any narrow view, the sacrificing of ambition, or the subordination of individuality, but it implies loyalty to a cause and to an organization. It means, what has long been clear and freely admitted, that many of the intricate problems in agriculture are larger than any individual, and that their solution as rapidly and completely as is humanly possible is something the public has a right to expect from these institutions. It is natural therefore that stations should frequently find it desirable to combine their labors and their forces. The fact that the director and his staff constitute the experiment station, and that they themselves in very large measure determine its working program, makes it a singularly democratic institution in which loss of individuality need rarely be feared. Merit will tend to attain its proper level.

Dean Thatcher, of Minnesota, has recently made a strong appeal for the adoption of "such a real spirit of coöperation as will bring to the solution of our problems the combined results of training and experience of all the workers who can contribute anything to either the immediate progress of an investigation or its final practical application." To develop such a spirit, he describes the conference groups of scientific workers which have been established at the Minnesota Station. The purpose is to provide an opportunity for frequent discussion and friendly criticism of the methods and results of research in progress, and to insure that when any new project is being considered all phases or scientific aspects of the problem may be given due consideration and properly provided for. The result has been a very pronounced growth of the general spirit of coöperation at that station. The plan is worthy of wider introduction.

A natural effect of thoroughly organizing the work may ultimately be felt in the type of problems attacked. There will, of course, be many projects which aim at the settlement of some

single fact or local question, but more and more the type of problems to be studied will be such as relate to broad fundamental questions of permanent character and wide application, bearing ultimately on the formulation of good agricultural policy and practice. These from their nature will inevitably call for relating the work of different departments, and suggest coöperation both in attack and in interpretation. General principles, broad underlying facts, and the understanding of their limitations and controlling factors, have a far more enduring value than results which pertain to minor questions or deal primarily with local aspects or conditions.

When the work of a station has been well organized, when each house has been set in order, the way is more clear for arranging for effective coöperation or coördination between stations. This should not be on too extensive a scale, especially at the outset, and should be as free as possible from complications and cumbersome machinery. A small number of undertakings are more likely to succeed than if the attempt is made to bring a large part of the work into coöperation. A few things well and satisfactorily done are more important than many less effective ventures. It is by success in coöperative effort that the plan will win friends and conviction, and will grow by its own force if the means are provided.

For most of the experiment stations the organization of their work with reference to what others are doing is no longer a matter of preference alone, but in a greater measure is impressed upon them by present conditions. Insufficient funds make such action necessary if the stations are to cover the field and render the service expected of them. Individual workers and separate stations have their quite distinct limitations, and their efforts may be materially supplemented and strengthened by those of other institutions. It should be realized that joint effort is a means of making the work of each station and each individual worker more effective.

The American stations comprise a system having a common purpose, as well as local responsibilities, and confronted with many problems common to regions extending far beyond state

boundaries. The stations do not exist merely to themselves or for their states. They have a unity of purpose, and a range of interest which is not confined to the local aspects of problems. They are interdependent. They can economize their time and funds, and make their efforts more productive of sound conclusions by so relating their work as to cover certain problems completely, make the attack more concentrated, and the results more readily comparable or intelligently harmonized.

Coöperation may lead to a more intensive study of the nature of the problem—what it really involves, what features or branches of science are included in its manifestations, and hence the means of approaching it, instead of viewing it from a one-sided, individualistic standpoint, or in the practical form in which it comes up to the station. One great need is a more careful definition of problems. In agriculture they are unusually complex, and the factors they embrace are often quite obscure. We are apt to see these problems in their composite character, as involved, practical questions, rather than in their fundamental aspects. Attempts to solve them in such form really aim at providing empirical rules for farming and usually lead to results which are themselves largely empirical.

Coöperation and correlation may result in minimizing duplication. Repetition is all right if warranted, but we all know there has been a vast amount of going over similar ground in a similar way without adding anything new that is material or contributing to the final solution. There is, of course, little reason for duplication which is not constructive and fails to take account of what has gone before.

Then again the lack of coöperation and better understanding has had an unmistakable effect on the public. Fragmentary, inconclusive and discordant results have led to criticism and lack of confidence. There is still need to inspire the confidence of the public, to create the feeling of dependence on the teachings of experimentation, and above all to avoid confusing the farmer and his teachers.

If the extension workers are to bank on experiment station results and conclusions, the latter must be well fortified and

beyond the controversial stage when they are given out for popular consumption; we should agree fairly well among ourselves, or understand why we do not agree without reservations. I think the station bulletin is an improper place for criticism and controversy. These are appropriate in their place, but their proper place is the scientific journals and the meetings of specialists. In the station bulletin they are likely to be misinterpreted and to weaken the position of investigators.

One essential to joint effort is the provision of conference of those involved or disposed to join hands. Nothing can take the place of this in organizing work, and in analyzing and determining what should be covered in the solution of a problem. Coöperation must be a democratic effort. A centralized, made-to-order plan, to be followed rigidly by those who participate, starts off wrong. Coöperation should begin with the outlining of the problem and the making of the plan. It is in this that the different views and breadth of knowledge of facts and conditions are of great advantage. Out of the exchange of ideas and the discussion of the real nature of the question at issue there should come more carefully digested and effective plans for attack.

Finally the plan should preferably be as simple and elastic as the subject will permit, leaving as much latitude as possible to individual initiative, preference, and ingenuity. The whole effort should be informal, but at the same time it should not be without coherence and follow-up, or it will disintegrate into unrelated, independent effort.

The most important thing at this time, therefore, is to recognize the advantage and develop the spirit of coöperation. The next is to provide the opportunity and means for it. There needs to be a wider knowledge of what is being done and where, such as you have attempted to provide, and there should be free intercourse among those engaged in common undertakings. I think it is becoming apparent that we have less and less to fear from unworthy competition as a result of exchange of ideas, and more and more to gain from combined and coördinated effort.

MILK PRICES AND COST OF MILK PRODUCTION

F. A. PEARSON

Dairy Husbandry Department, University of Illinois, Urbana, Illinois

INTRODUCTION

The present study pertains to the seasonal cost of producing milk for direct consumption. Numerous organizations in various parts of the United States have made from time to time many studies of the cost of milk production, but in most instances these data involve what is known as the year cost of milk production. Little or no attention has been given to the seasonal variations in the cost of producing this important commodity.

The question of seasonal variations in the cost of fat production was discussed briefly in 1914 before the American Farm Management Association and later the proceedings were published by the association.[1] The present study presents quantitative results which set forth in rather precise form the large variation in the cost of producing milk for urban consumption in the different months of the year.

SOURCE OF DATA

The Department of Dairy Husbandry has been carrying on detailed cost-accounting investigations pertaining to various problems of dairy farm administration since 1912. The data presented in this bulletin involve eighteen of the thirty-six farms included in the study of the year cost of milk production published as Bulletin 216 of this station.[2]

[1] Proceedings of 5th Annual Meeting of American Farm Management Association.

[2] Pearson, F. A. The Cost of Milk Production Computed on Year Basis. 1919, p. 24.

COW COST OF MILK PRODUCTION BY MONTHS

The cow cost of milk production involves only the maintenance of the bulls and the milking stock; the cost of rearing the young stock is not included. The milking herds are maintained by purchasing cows or by replacing depleted stock with heifers raised in the herd.

The data presented in table 1 involve 407 cows and 19 bulls, the cows producing 2,806,277 pounds of milk at a net cost of $48,479.67, or $1.73 per hundredweight. It will be noted that the net winter cost of producing this milk was $31,669.94, or $1.98 per hundredweight, and the summer cost, $16,809.73, or $1.40 per hundredweight. The monthly cost varied from $1.15 per hundredweight in June to $2.08 in December and February.

VARIATION IN FEED EXPENSE

For the herds under consideration the feed expense per hundredweight of milk produced, varied from 40.1 cents in June to $1.41, or over three times as much, in December, with an average of $1.05 for the year. For the winter months the feed expense aggregated $21,307.29, or $1.33 per hundredweight of milk, and for the summer months, $8,159.56, or $0.68 per hundredweight of milk.

VARIATION IN LABOR EXPENSE

The expense of man labor per hundredweight of milk produced varied from 27.9 cents in June to 41.0 cents in December, with an average of 36.3 cents for the year. During the winter six months an average of 11.7 hours per day of man labor was spent on each herd, while in the summer months an average of only 7.9 hours per day was used.

While the variations exhibited in the labor expense are not so great as those shown in feed expense, they are still great enough to contribute materially to the large variation in the total cost of production.

TABLE 1

Cow cost of milk production for the year and for each month of the year

	YEAR	WINTER MONTHS					
		November	December	January	February	March	April
Milk production in pounds.....	2,806,277	227,269	262,129	278,653	267,295	294,776	272,607
Items of expense:							
Feed other than pasture...	$27,538.52	$3,151.30	$3,681.69	$3,855.00	$3,799.18	$3,691.92	$3,015.83
Pasture.....	1,928.33	92.68	3.56				16.13
Man labor.....	10,193.90	878.56	1,074.75	1,063.42	1,031.67	1,109.82	972.48
Live-stock depreciation....	5,922.83	479.68	553.24	588.11	564.14	622.14	575.35
Interest on stock.....	2,372.16	197.68	197.68	197.68	197.68	197.68	197.68
Horse labor.....	2,274.38	173.85	231.36	217.37	205.60	243.98	205.22
Use of buildings.....	2,019.72	163.57	188.66	200.55	192.38	212.15	196.20
Miscellaneous.....	1,740.17	140.94	162.55	172.79	165.75	182.79	169.04
Use of equipment.....	. 350.83	28.40	32.77	34.84	33.42	36.85	34.08
Total.....	$54,340.84	$5,306.66	$6,126.26	$6,329.76	$6,189.82	$6,297.33	$5,382.01
Returns not milk:							
Manure.....	$3,695.17	$485.91	$516.21	$540.97	$545.04	$523.24	$513.26
Calves.....	2,166.00	242.69	151.67	212.35	91.01	72.81	66.74
Total.....	$5,861.17	$728.60	$667.88	$753.32	$636.05	$596.05	$580.00
Net cost.....	$48,479.67	$4,578.06	$5,458.38	$5,576.44	$5,553.77	$5,701.28	$4,802.01
Net cost per hundredweight...	1.73	2.01	2.08	2.00	2.08	1.93	1.76

	SUMMER MONTHS					
	May	June	July	August	September	October
Milk production in pounds	284,867	239,145	190,701	149,785	140,108	198,942
Items of expense:						
Feed other than pasture	$1,379.37	$638.17	$758.21	$880.60	1,053.82	$1,633.43
Pasture	285.07	331.05	297.91	290.98	328.62	292.33
Man labor	826.43	666.36	654.41	606.01	590.92	719.07
Live-stock depreciation	601.23	504.73	402.49	316.13	295.71	419.88
Use of buildings	205.02	172.12	137.25	107.80	100.84	143.18
Horse labor	204.33	161.46	156.35	150.20	146.42	178.24
Interest on stock	197.68	197.68	197.68	197.68	197.68	197.68
Miscellaneous	176.65	148.29	118.25	92.88	86.88	123.36
Use of equipment	35.61	29.90	23.84	18.73	17.52	24.87
Total	$3,911.39	$2,839.76	$2,746.39	$2,661.01	$2,818.41	$3,732.04
Returns not milk						
Manure	$189.93	$33.26	$41.39	$45.82	$66.51	$193.63
Calves	139.55	48.54	103.14	133.48	424.71	479.31
Total	$329.48	$81.80	$144.53	179.30	491.22	672.94
Net cost	$3,581.91	$2,757.96	$2,601.86	$2,481.71	$2,327.19	$3,059.10
Net cost per hundredweight	1.26	1.15	1.36	1.66	1.66	1.54

QUANTITIES OF FEED AND LABOR PER HUNDREDWEIGHT OF MILK

By an inspection of table 2 it will be noted that with the cow as the unit of computation, the value of the man labor, grain, hay, dry forage, and succulent feeds represents 77.8 per cent of

TABLE 2

Cow cost of milk production: Amounts of man labor and feed other than pasture required to produce 100 pounds of milk, and the percentage which the value of these forms of the net cost

	YEAR	WINTER MONTHS						
		January	February	March	April	November	December	Winter, six months
Man labor (hours)	2.29	2.39	2.43	2.39	2.26	2.42	2.56	2.41
Feed								
Grain (pounds)	32.4	41.5	51.6	48.3	39.8	40.0	41.7	43.9
Hay (pounds)	36.4	58.0	52.5	47.1	43.2	60.1	59.1	53.0
Other forage (pounds)	25.9	49.1	41.1	35.6	24.6	55.9	49.4	42.1
Silage (pounds)	154.0	204.2	183.4	154.7	162.8	183.8	214.6	183.2
Percentage that feed and labor form of net cost	77.8	88.1	87.0	84.2	83.1	88.0	87.1	86.3

	SUMMER MONTHS						
	May	June	July	August	September	October	Summer, six months
Man labor (hours)	1.85	1.76	2.18	2.58	2.69	2.28	2.15
Feed							
Grain (pounds)	20.6	13.7	13.4	12.9	15.5	26.7	17.6
Hay (pounds)	14.9	1.7	8.6	13.8	20.0	29.9	14.2
Other forage (pounds)	0.78	0.29	0.37	0.48	8.7	17.8	4.3
Silage	79.3	49.9	91.4	192.5	227.4	130.5	115.0
Percentage that feed and labor form of net cost	61.6	47.3	54.3	59.9	70.7	76.9	61.9

the net yearly cost of producing the milk. The percentage which feed and labor constituted varied from 47.3 in June to 88.1 in January.

The amount of labor per 100 pounds of milk varied from 1.76 hours in June to 2.69 hours in September, averaging 2.29

hours for the year. The grain fed per 100 pounds of milk varied from 13.7 pounds in June to 51.6 pounds in February, averaging 32.4 pounds for the year.

The amounts of feed and hours of labor, and the percentage which the total value of these forms of the net cost, being determined, it is relatively simple to determine the approximate cost of milk production for any given period. The costs being expressed in commodities may be converted into terms of value by applying farm prices to these units.

Assuming the prices are as follows the June cost would be:

Grain	13.70 pounds at $55 per ton =	$0.377
Silage	49.90 pounds at 6 per ton =	.150
Hay	1.70 pounds at 10 per ton =	.009
Other roughage	.29 pounds at 6 per ton =	.001
Man labor	1.76 hours at 25 cents per hour =	.440
Value of feed and labor		$0.977
Proportion that feed and labor form of total net cost		47.3 per cent
Net cow cost of milk per hundredweight		$2.07

Figured in a similar manner, the December cost would be $3.30 per hundredweight of milk; the summer cost, $2.34; the winter cost, $3.19; and the year cost, $2.81.

SIGNIFICANCE OF SEASONAL VARIATIONS IN FEED AND LABOR EXPENSE

In the past due significance has not been attached to the rôle that pasture plays in dairy farming. The most popular method of dispensing with the pasture question has been to contrast the total amount of food secured from an acre of pasture with the amount secured from an acre of corn silage or alfalfa. However, in spite of much advice to the contrary, the dairy farmers have continued to make general use of pasture since the cheapest food for the summer months is obtained in this way and the farmer is enabled to reduce the amount of labor spent on the herd. As the months favorable to pasturing stock approximately coincide with the crop season, this reduction in the amount of labor spent on the herd enables the farmer to spend more labor on the crops.

On the eighteen farms under discussion, the man labor devoted to the production of milk during the summer months totalled 27,632.5 hours, an average of 152 hours per day. In the winter months it amounted to 43,533.0 hours, or 238 hours per day. The difference per day per farm between summer and winter was 4.8 hours.

The expense for feed in the summer months is much less than in the winter months. In this study, in the month of June, when pastures are best, the feed expense was considerably less than one-third the average for the winter months. This was due to the fact that much more grain was fed per hundredweight of milk in the winter months than in the summer months.

Pasture is a crop which is in most cases planted, grown, and harvested without much assistance from the farmer. Dairy farmers pasture-feed in the summer, rather than barn-feed, because they usually have in permanent blue grass some land which cannot be tilled with profit. Pasture reduces the amount of labor spent on the herd and permits more time to be spent with the crops during a period when the returns secured from labor spent on crops are relatively large compared with returns from the herd. If the farmers did not pasture their stock in the summer and yet continued in the dairy business, barn-feeding during the summer months, more buildings would have to be maintained to house the additional feed necessary, or fewer cows would have to be kept. Farmers without pasture who embark in the dairy business and sell to the ordinary markets have one of two alternatives: either they must barn-feed in the summer, or they must turn good crop land into pasture. The first alternative, in the absence of a large amount of unpaid labor, is very unprofitable. The latter, although unprofitable, is probably less so than the former.

SEASONAL VARIATION IN COST OF PRODUCTION AND THE PRICE OF MILK

The price of a commodity must in the long run cover the cost of production or production will be diminished. Milk is no exception to this rule. Furthermore, the price of a commodity

like milk for urban consumption, which is both bulky and perishable, must fluctuate approximately with the cost of production or prodcution will be concentrated in the more profitable seasons.

The accompanying figure presents graphically the monthly percentage variation in the price paid for milk at the Chicago market during the ten years 1907 to 1916[3] and in the cost of production with the cow as the unit.

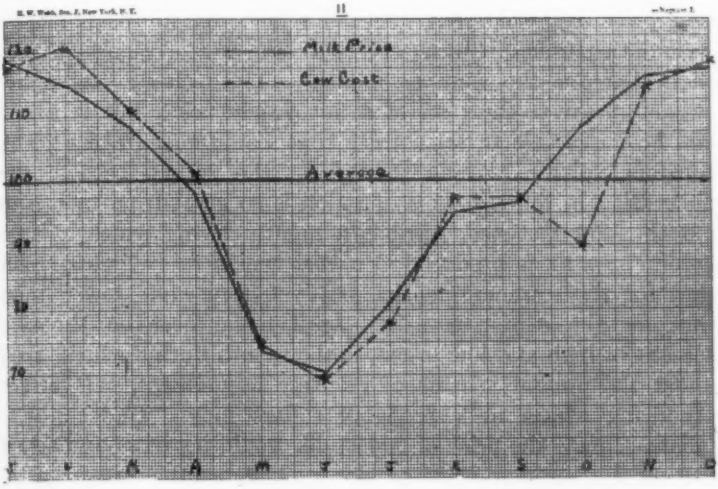


FIG. 1

These curves indicate that in general the monthly variation in the price of milk has followed more or less closely the monthly variation in the cost of production. The price of milk tends to vary somewhat less than either the herd cost or the cow cost of production, not rising so high in the winter nor falling so low in the summer. The monthly cow cost per hundredweight of milk varies from 122 per cent in February and December to 67 per cent in June. The price of milk varies from 120.3 per cent in December to 70.6 per cent in June.

[3] For tabular presentation, see page 356 of Bulletin 216.

In the past many persons have recommended a flat price for milk throughout the year. This recommendation has usually been made in the absence of due appreciation of the wide variation in the monthly cost of production. A flat yearly price for milk is out of the question, as production would tend to concentrate in the summer months of low cost. This would result in a supply in the winter season that would not be sufficient to meet the demand.

Other persons, admitting that a flat yearly price is not practical have suggested that prices should be on the basis of two six-month periods, with the price for the winter months higher than that for the summer months. This scheme has many advantages over the plan of a flat yearly price, but it would still be impossible to set a price that would encourage a fairly constant volume of milk throughout the period, because the fluctuation in the cost of production is so great from month to month. For instance, April is a month during which a large volume of milk is produced at a cost considerably greater than that for the summer months, but yet somewhat lower than that for the winter months. April being between the two seasons of high and low prices, is the month during which, even under the present scheme of monthly adjustment, the farmer producing winter milk probably suffers most. Under a six-month scheme the price of April milk would have to be either as low as the summer price or else as high as the winter price. The former would be a handicap to the producer and the latter a burden to the buyer.

Again, it would not be satisfactory to sell milk in June, when there is usually a surplus, at the same price as in August and September, when there is usually a scarcity, although these months occur in what are known as the summer months. Similar discrepancies could be pointed out for the winter months.

Owing to the great variation in the monthly cost of milk production, a flat price for any extended period would probably shift production to the more profitable months. Since milk production is so sensitive to changes in prices, the milk producer, the milk distributor, and the milk consumer are best protected

through a fluctuating price, which insures, so far as it now seems possible, a fairly constant supply of milk. If the price of milk fluctuates approximately with the cost of production, the distributor's supply is automatically regulated, the milk producer's market is protected, and the consumer is assured of a normal supply of milk throughout the year.

CONCLUSIONS

1. The amount of man labor involved in the production of milk is considerably less in the summer months than in the winter months. This is true whether based upon the total amount of labor used on the herd or whether based upon the amount involved in the production of 100 pounds of milk. Proper significance of this reduction in labor is appreciated only when attention is drawn to the fact that these savings in labor occur during the pasture season, which coincides with the crop season, when the maximum labor is needed in the field.

2. Aside from man labor, feed, and horse labor, the expenses of producing milk are more or less constant throughout the year. When all expenses are included, the net cost of producing 100 pounds of milk in June is about 60 per cent of the year cost, and in December about 120 per cent.

3. With a fluctuating seasonal cost, it is to be expected that farmers will tend to concentrate production in the more profitable months. As the urban trade demands a constant supply of milk throughout the year, the price of milk must fluctuate approximately with the cost of production in order to prevent an extreme shortage at one time and a large surplus at another. In other words, a properly adjusted fluctuating price for milk throughout the year protects the farmer's market and the distributor's and consumer's supply.

A MODIFICATION OF THE HAECKER AND SAVAGE FEEDING STANDARDS FOR DAIRY CATTLE

ANDREW C. McCANDLISH

Dairy Husbandary Section, Iowa State College, Ames, Iowa

The feeding standards have now come to be recognized as valuable adjuncts to the teaching of the principles of feeding and as criteria by which rational feeding methods can be outlined. However, consideration must be given to the fact that no feeding standard can ever be looked on as determining definitely the amounts of nutrients that must be supplied to certain animals, for the simple reason that the individuality of an animal is a very variable factor and at the same time is the chief one in determining the feed requirements of the animal. In addition there are certain factors in nutrition, such as the variations in the quality of the proteins; the occurrence and distribution of the "vitamines," and the requirements of the animals for ash, that are not considered in feeding standards. In spite of these drawbacks the feeding standards are of great value and have come to stay. The present problem is to render the standards not only more nearly accurate but also more easily applicable.

All of the standards in use can be considered as modifications of the Wolff-Lehmann standard, those of Haecker (3) and Savage (5) being stated in terms of digestible nutrients while the standards of Armsby (1) and Eckles (2) are given in terms of digestible true protein and net energy. No effort will be made to discuss the accuracy or relative merits of the standards but a suggested modification of those based on digestible nutrients will be given.

The Haecker standard (3) is given in terms of digestible crude protein, digestible carbohydrate and digestible fat and the use of three units of measurement obviously renders it somewhat cumbersome. The Savage standard (5) modifies the Haecker standard somewhat and is stated in terms of digestible crude protein and total digestible nutrients, this latter term being the

sum of the digestible crude protein, the digestible carbohydrate, and $2\frac{1}{4}$ times the digestible fat. There is a distinct disadvantage in using the two terms, digestible crude protein, and total digestible nutrients.

When a ration is calculated according to this standard it is easy to see where the protein in the trial ration meets the requirements of the standard but it is difficult to determine when the carbohydrate equivalent portion of the ration meets the requirements. For example, if the protein requirements should not be met with the trial ration and the total digestible nutrients should appear to be correct it is evident that the carbohydrate equivalent portion of the ration is incorrect and a mental calculation must be made to determine the necessary amount of carbohyhydrate equivalent that must be added or deducted in order to bring the ration into line with the requirements of the standard.

A still further modification has been made by Morrison (4) by simply using the Haecker and Savage protein requirements as minima and maxima respectively and giving the requirements for total digestible nutrients as the average of the requirements of the two standards. In the practical use of the standard the range in protein requirements is not used as a general rule, the common practice being to use the average of the two for protein requirements.

Consequently, the table presented here has been calculated so that the protein requirements given are the averages of those called for by the Haecker and Savage standards and the carbohydrate equivalent requirements of the two standards have also been calculated and averaged. In this way the requirements of an animal can be stated in two simple terms—digestible crude protein and digestible carbohydrate equivalent—which are independent of each other.

The requirements for the production of one pound of milk, ranging from 2.5 per cent to 7.0 per cent in butterfat content are given. The maintenance requirements for use with this table are 0.0700 pound of digestible crude protein and 0.7925 pound of digestible carbohydrate equivalent per 100 pounds live weight.

TABLE 1

Digestible nutrients required for the production of 1 pound of milk

FAT IN MILK	DIGESTIBLE NUTRIENTS	
	Crude protein	Carbohydrate equivalent
per cent	*pounds*	*pounds*
2.5	0.0459	0.1999
2.6	0.0466	0.2045
2.7	0.0473	0.2091
2.8	0.0480	0.2139
2.9	0.0487	0.2198
3.0	0.0494	0.2246
3.1	0.0501	0.2295
3.2	0.0508	0.2344
3.3	0.0515	0.2402
3.4	0.0522	0.2453
3.5	0.0529	0.2511
3.6	0.0536	0.2560
3.7	0.0543	0.2619
3.8	0.0550	0.2667
3.9	0.0557	0.2715
4.0	0.0564	0.2774
4.1	0.0571	0.2823
4.2	0.0578	0.2871
4.3	0.0585	0.2919
4.4	0.0592	0.2968
4.5	0.0600	0.3016
4.6	0.0607	0.3061
4.7	0.0614	0.3100
4.8	0.0621	0.3146
4.9	0.0628	0.3183
5.0	0.0635	0.3230
5.1	0.0642	0.3278
5.2	0.0649	0.3313
5.3	0.0656	0.3362
5.4	0.0663	0.3397
5.5	0.0670	0.3445
5.6	0.0677	0.3481
5.7	0.0684	0.3529
5.8	0.0691	0.3575
5.9	0.0698	0.3614
6.0	0.0705	0.3659
6.1	0.0712	0.3697
6.2	0.0719	0.3745
6.3	0.0726	0.3781
6.4	0.0733	0.3840
6.5	0.0741	0.3875
6.6	0.0748	0.3913
6.7	0.0755	0.3948
6.8	0.0762	0.3996
6.9	0.0769	0.4043
7.0	0.0776	0.4070

REFERENCES

(1) ARMSBY, H. P. 1917 The nutrition of farm animals.
(2) ECKLES, C. H. 1913 Nutrients required for milk production. Res. Bul. Mo. Agr. Expt. Sta. 7.
(3) HAECKER, T. L. 1914 Feeding dairy cows. Bul. Minn. Agr. Expt. Sta. 130.
(4) MORRISON, F. B. 1915 The modified Wolff-Lehmann standards. Proc. Am. Soc. Animal Prod., p. 64.
(5) SAVAGE, E. S. 1912 A study of feeding standards for milk production. Bul. Cornell, N. Y. Agr. Expt. Sta. 323.

FISHY FLAVOR IN BUTTER[1]

J. T. CUSICK

Dairy Industry Department, Cornell University, Ithaca, New York

INTRODUCTION

The improvement of the quality of butter has been the aim of investigators and manufacturers of dairy products for many years. Abnormal flavors and odors in milk, cream, butter and cheese have caused the dairyman endless trouble and annoyance. To preserve the normal flavor in butter and cheese, the efforts of the dairyman have been directed almost entirely in the direction of controlling the methods of manufacture of these products, while little attention has been given to chemical and bacteriological changes produced by the various methods used. The effect of the various methods of handling and treating milk and cream have had little interpretation as to the chemical changes produced in these products or the influence of bacterial growth. It is noted that chemical changes are produced in cream handled in certain ways, and the chemical changes in the pabulum of the bacteria must have its influence on the growth of the various types of organisms retained in the resulting butter. Butter handled one way seldom if ever goes "fishy," while to diverge from this certain method of handling the cream before churning would endanger the quality of the resulting product. The presence of a chemical substance, having a flavor and odor of decomposed fish, must necessarily be produced in the butter by synthesis or decomposition of some of the components of the cream. As the decomposition of one of the constituents of the butter would theoretically give a substance having a fishy flavor and odor, it may be concluded in the light of recent investigation, that this substance—tri-methylamine—is the cause of fishy flavor in butter. What is the rôle played by bacteria in bringing about this change is the subject of our investigation.

[1] This work was done in the Department of Dairy Industry, N. Y., State College of Agriculture, under the direction of Prof. W. A. Stocking.

REVIEW OF LITERATURE

In 1900, fishy flavor and odor were found in milk by Harding, Rogers and Smith (1) at the New York Agricultural Experiment Station at Geneva. In this case the milk from a single member of a herd of cows was found to have a strong fishy odor and taste. However, the reason for the milk from this particular cow being "fishy" was not ascertained. An organism suspected of causing the abnormal flavor was isolated and various experiments performed to determine if the suspected organism would reproduce fishy flavor. No positive results were obtained.

O'Callaghan (2) (1901) declared that Oidium lactis was the cause of fishy flavored butter. Even unsalted butter was reputed to have developed this disagreeable flavor. His work was repeated by Rogers and also by Reakes, Cuddie and Reid (3) (1912). They all agreed that Oidium lactis was not the cause of fishy flavor. The latter authors conclude that:

> The development of fishy flavor in butter arises as a result of a chemical change including a splitting up of some of the constituents into compounds possessing this peculiar character and taste, the factors responsible for such change being apparently of a degree of high acidity of the cream and overworking.

Harrison (4), however, agrees that fishy flavor in butter is due to the presence and growth of undesirable bacteria in cream.

Rogers (5) (1914) gave out the information that fishy flavor is usually preceded by an oily or a metallic flavor. He found that fishy flavor is not prevented by low temperatures, but only retarded by them. Also that salts of iron and copper accelerate the production of fishy odor and taste. He never found fishy flavor in unsalted butter.

> In the opinion of the writer, fishy flavor is caused by the slow, spontaneous chemical change to which acid is essential and which is favored by the presence of small amounts of oxygen. Fishy flavor may be prevented with certainty by making butter from pasteurized sweet cream. Butter made from pasteurized sweet cream with starter, but without ripening, seldom if ever becomes fishy.

Hunziker (6) (1915) found that high pasteurizing temperatures, such as 185°F. and higher, may cause a very poor quality of butter. The butter seemed to have a disagreeable oily flavor suggesting also that of decomposed fish. This occurred more particularly in summer when the cows are in pasture and the butter fat contains more than the average amount of olein. The action of high acid and high temperature on the olein, Hunziker thinks, is the cause of fishy flavor in this instance.

Hammer (7) (1917) isolated an organism from a can of evaporated milk that had a strong fishy odor and flavor. He inoculated both sterile and pasteurized milk and cream with this organism and fishy flavor developed in a few hours. In inoculated milk there was also produced coagulation and digestion. He was, however, unable to produce fishy flavor in butter either by inoculating the butter directly or by adding the culture to the cream before churning.

In some lots of butter, salt was used, while other lots were unsalted. The counts made showed that the number of bacteria per gram decreased throughout the holding period with butter made from sour cream and with salted butter made from sweet cream, while with unsalted butter made from sweet cream there was an increase followed by a decrease.

The organism was called Bact. ichthyosmius.

In repeating Hammer's work, butter was made from cream which had been inoculated with a culture of Bact. ichthyosmius, and in some cases fishy flavor developed in the butter after a few months in storage. The cause of the fishy flavor is not credited entirely to the Bact. ichthyosmius as the treatment of the cream before churning seems to have brought about chemical changes in the product which evidently were responsible for the development of the undesirable odor and taste in the butter.

PLAN OF THE EXPERIMENT

Cream containing 30 per cent butter fat was used to make the butter for these experiments, and the six portions taken treated as follows:

Portion D. About 750 cc. of sweet cream was pasteurized at 145°F. for thirty minutes, and then cooled to 48°F. The cream was then inoculated with 1 cc. of an aqueous solution containing a culture of Bact. ichthyosmius which had been grown on an agar slant. This organism was isolated from a group of ten, and was the only one to produce fishy odor in sterilized milk. The butter was made in the usual manner, one half of the portion was salted, while the other half was not. Both samples were stored in a refrigerator at 15°F. Another sample of cream was treated in the same manner as the above sample except that it was not inoculated. This latter was a check sample for D.

Portion E. This sample of sweet raw cream was inoculated like the preceding sample, incubated at 98°F. for three hours; cooled to 60°F. and then churned. From this point E and all of the following samples were treated the same as in sample D.

Portion K. The sweet cream was inoculated; incubated at 98°F. for three hours, the acidity neutralized to phenolphthalein with sodium hydroxide, and churned at 60°F.

Portion N. The cream here was inoculated, incubated, and neutralized as in portion K. After neutralizing, one ounce of liquid starter was added, and the mixture allowed to stand at room temperature for three hours before churning.

Portion R. This portion was inoculated; one ounce of starter added, and the cream allowed to stand at room temperature for three hours to ripen. At the end of three hours it was neutralized and then churned.

Portion X. This last sample was inoculated, incubated for three hours at 98°F.; cooled to 60°F., starter added; and churned after three hours.

Each portion of cream then was represented by an unsalted sample of butter as well as a salted sample inoculated with Bact. ichthyosmius, and a check sample which was not inoculated, but was salted. These were all stored at 15°F. Every two weeks, during a period of eight months, a bacteria count was made on both the inoculated samples from each portion. The colonies were grown on lactose agar. The counts noted in the portions represent the number of bacteria per gram of butter. All three samples from each portion were scored frequently for quality (flavor).

General summary of the work of scoring. No check (uninoculated) sample was scored "fishy." No unsalted, inoculated, sample was scored "fishy." Salted sample from portion D (inoculated), made from fresh cream which was pasteurized and then churned at once, was not scored "fishy." The bacteria decreased rapidly both in the salted and in the unsalted sample. Samples from portion E were not scored "fishy." The bacteria count on the salted sample was 120,000,000 at the time it was churned, and at the end of six months the count was 460,000. The unsalted sample had a count of only a few hundred at the end of four months. The only difference between this portion and the preceding was in the neutralization of the sample after incubation. The salted sample of portion N was accidently destroyed at the beginning of the fourth month in storage. However, the author scored the sample "fishy" a short time before the accident. Portion R after four months in storage had a strong fishy odor. At the end of seven months the odor had disappeared somewhat. The salted sample from portion X was scored "fishy" by one of the judges, "tallowy" by another, while the two remaining judges scored it "metallic." The number of bacteria per gram of butter in this sample was several million even after it had been in storage for several months.

DATES OF PLATING	D.		D. S.	
	Bacteria per gram	Scored 10/28	Bacteria per gram	Scored 10/28
3/19	23,400,000		62,000	
4/2	18,250,000		5,000	
4/16	11,500,000		2,150	
4/30	7,500,000		2,000	
5/14	4,050,000	1. 0	1,900	1. 0
5/29	3,000,000	2. 0	700	2. 0
6/11	600,000	3. 0	500	3. 0
6/25	505,000	4. 0	200	4. 0
7/9	435,000		000	
7/24	405,000			
8/7	285,000			
8/21	45,000			

D. = Made from sweet cream, pasteurized, and churned at once.
D. S. = Same as D. except salted.
Acidity of both, 0.135 per cent.

DATES OF PLATING	N.		N. S.	
	Bacteria per gram	Scored 10/28	Bacteria per gram	Scored
3/19	1,232,000,000		16,600,000	
4/2	42,000,000		8,950,000	
4/16	25,000,000		6,650,000	
4/30	20,000,000		6,400,000	
5/14	20,050,000		5,450,000	
5/29	18,800,000	1. 0	4,600,000	
6/11	18,600,000	2. 0	3,750,000	
6/25	5,800,000	3. 0	Sample accidentally destroyed	
7/9	2,850,000	4. 0		
7/24	1,780,000			
8/7	205,000			
8/21	70,000			

N. = Sweet cream, pasteurized, inoculated at room temperature, neutralized, and then ripened with B.l.a.

N. S. = Same as N. except salted.

Acidity of samples, 0.32 per cent.

DATES OF PLATING	R.		R. S.	
	Bacteria per gram	Scored 10/28	Bacteria per gram	Scored 10/28
3/19	1,600,000,000		10,400,000	
4/2	8,750,000		10,100,000	
4/16	7,800,000		8,300,000	
4/30	Plate badly		6,700,000	
5/14	contami-		6,350,000	
5/29	nated with		4,000,000	
6/11	fleshy col-		1,350,000	
6/25	onies after	1. 0	595,000	1. Fishy
7/9	third count	2. 0	670,000*	2. Oily
7/24	was made	3. 0	740,000*	3. Fishy
8/7	on this	4. 0	455,000*	4. Fishy
8/21	sample		370,000	
9/4			350,500	
9/26			320,000	
10/28			215,000	

*Fishy odor on plates at time of counting.

R. = Sweet cream, pasteurized, inoculated, incubated at room temperature, neutralized, ripened with B.l.a. and again neutralized.

R. S. = Same as R. only salted.

Acidity of both samples at time of neutralization was 0.36 per cent.

Sample R. is noticed here only to compare its score with that of R. S.

DATES OF PLATING	X.		X. S.	
	Bacteria per gram	Scored 10/28	Bacteria per gram	Scored 10/28
3/19	900,000,000		32,700,000	
4/2	46,050,000		30,250,000	
4/16	31,800,000		28,000,000	
4/30	2,500,000		17,400,000	
5/14	2,160,000	1. 0	14,150,000	1. Metallic
5/29	1,950,000	2. 0	11,500,000	2. Metallic
6/11	1,810,000	3. 0	11,200,000	3. Tallowy
6/25	165,000	4. 0	6,400,000	4. Fishy
7/9	124,500		5,400,000	
7/24	56,000		4,300,000*	
8/7			4,000,000*	
8/21			4,500,000	
9/4			4,600,000	
9/26			3,200,000	
10/28			4,200,000	

* Fishy odor on plates at time of counting.

X. = Sweet cream, pasteurized, inoculated, incubated at room temperature, and then ripened with B.l.a.

X. S. = Same as X. only salted.

Acidity of samples at time of churning was 0.297 per cent.

DATES OF PLATING	K.		K. S.	
	Bacteria per gram	Scored 10/28	Bacteria per gram	Scored 10/28
3/19	52,900,000		23,400,000	
4/2	46,000,000		14,400,000	
4/16	40,500,000		10,450,000	
4/30	34,000,000		8,500,000	
5/14	27,400,000	1. 0	6,300,000	1. Metallic
5/29	26,150,000	2. 0	1,800,000	2. 0
6/11	27,100,000	3. 0	1,800,000	3. Fishy
6/25	27,900,000	4. 0	1,150,000	4. Fishy
7/9	18,600,000		890,000	
7/24	14,650,000		750,000	
8/7	7,500,000		Plates became too clouded for further study	
8/21	2,200,000			
9/4	515,000			
9/26	460,000			
10/28	Cloudy plates			

No fishy odor was detected from any of these plates.

K. = Sweet cream, pasteurized, inoculated, incubated at room temperature, and then neutralized before churning.

K. S. = Same as K. only salted.

Acidity of samples at time of neutralization was 0.45 per cent.

DATES OF PLATING	E.		E. S.	
	Bacteria per gram	Scored 10/28	Bacteria per gram	Scored 10/28
3/19	27,200,000		120,500,000	
4/2	11,450,000		43,250,000	
4/16	6,100,000		22,950,000	
4/30	2,800,000	1. 0	17,000,000	1. 0
5/14	2,330,000	2. 0	5,050,000	2. 0
5/29	850,000	3. 0	2,950,000	3. 0
6/11	785,000	4. 0	2,910,000	4. 0
6/25	170,000		1,990,000	
7/9	50,000		1,225,000	
7/24	19,000		1,205,000	
8/7	000		990,000	
8/21			1,030,000	
9/4			1,005,000	
9/26			460,000	
10/28			241,000	

E. = Sweet cream, pasteurized, inoculated, incubated at room temperature before churning.

E. S. = Same as E. only salted.

Acidity of both samples before churning, 0.45 per cent.

In some of the samples of the experiment, fishy flavor was produced by inoculating the cream with Bact. ichthyosmius. The handling of the cream before churning affected the growth of the bacteria differently in every portion. To show how the samples of butter are affected chemically by the different methods of handling the cream, tables 1, 2, and 3 are given here showing a series of butter made from cream which was handled in various ways and which are comparable to the ways in which the cream portions of the inoculation experiments were treated. For instance, portion D compares very favorably with portion 6 of table 1 as to the way it was treated before churning. Portion 6 retained a large amount of its total phosphorus, and the soluble organic phosphorus suffered little, if any, decomposition. Portion E may be compared with portion 2 of table 1. The total phosphorus in 2 is very high, and the soluble organic phosphorus is large in amount. The portions which were scored "fishy" K. X. and R. underwent treatment similar to portion four (4) in table 1. This portion four (4) showed a very small amount

of organic phosphorus in the organic form, and it may be inferred that some of its organic phosphorus (soluble) had been decomposed. By comparison, all three samples (K. X. and R.) prove that where there is a loss of soluble organic phosphorus, fishy flavor develops in the butter. The only possible organic phos-

TABLE 1

*Salted samples of butter made 1/11/18, analyzed 1/28/18**

BUTTER FROM CREAM PORTION NUMBER	PER CENT OF P_2O_5				
	Soluble inorganic	Total soluble	Soluble organic	Protein residue	Total
1	0.0129	0.0156	0.0027	0.0123	0.0338
2	0.0138	0.0168	0.0030	0.0108	0.0397
3	0.0100	0.0124	0.0024	0.0079	0.0249
4	0.0127	0.0132	0.0005	0.0131	0.0351
5	0.0170	0.0202	0.0032	0.0103	0.0414
6	0.0155	0.0180	0.0025	0.0095	0.0344
7	0.0108	0.0124	0.0016	0.0089	0.0300

*From "Phosphorus in Butter" by this author.

TABLE 2

Analyses of above samples April, 1919

BUTTER FROM CREAM PORTION NUMBER	PER CENT OF P_2O_5				
	Soluble inorganic	Total soluble	Soluble organic	Protein residue	Total
1	0.0158	0.0204	0.0046	0.0120	
2	0.0232	0.0236	0.0004	0.0163	
3	0.0191	0.0193	0.0002	0.0086	Totals checked
4	0.0157	0.0168	0.0011	0.0163	
5	0.0227	0.0242	0.0015	0.0166	
6	0.0201	0.0211	0.0010	0.0115	
7	0.0148	0.0207	0.0059	0.0091	

TABLE 3

Unsalted sample portion 2 of above butter

	PER CENT OF P_2O_5				
	Soluble inorganic	Total soluble	Soluble organic	Protein residue	Total
2. Analyzed 1/28/18.....	0.0158	0.0199	0.0041	0.0139	0.0468
2. Analyzed 4/4/19.....	0.0229	0.0250	0.0021	0.0147	

phorus which is readily soluble in salt solution is lecithin. Butter contains lecithin, and one of the decomposition products of lecithin is choline. This choline is decomposed giving trimethylamine which has the odor and flavor of decomposed fish. Undoubtedly in the treatment of cream in certain ways, the lecithin is broken down to a form which is used as pabulum specifically by the Bact. ichthyosmius.

At the end of the period of storage the organism was isolated from a sample of butter which had been scored "fishy," and its identity determined.

Morphology

Form: rod shaped.
Size: 1μ to 2μ long, and from 0.6μ to 0.8μ wide.
Arrangement: isolated.
Motility: actively motile.
Staining reaction: Gram negative.
Spore formation: none found.

Cultural characteristics

Agar streak: dirty-white growth, non-viscid.
Agar stab: dirty white growth on surface and throughout the entire length of the stab.
Agar plate colonies: ellipsoidal colonies, white by reflected light and brown by transmitted light.
Milk: peptonized.
Litmus milk: peptonization and production of acid.

Bio-chemical features

Gas production: gas in bouillon containing sucrose, but not with lactose.
Indol: positive tests in bouillon and in milk.

All the above characteristics are in perfect agreement with those found by Hammer for Bact. ichthyosmius.

As may be seen from the counts on the different samples of butter, the number of bacteria decreased rapidly, in most cases,

in the unsalted samples and in the salted samples which did not go "fishy," while in the salted samples which did develop a fishy flavor the decrease in the numbers of bacteria was gradual. No unsalted samples were scored "fishy," nor has fishy flavor been found in unsalted samples of butter in any of our work. The check samples which were not inoculated with Bact. ichthyosmius but which were treated in every way as those described in the data given above, were kept in every instance, and in no case was fishy flavor observed in any of them. Only three of the samples were scored "fishy," and the methods of handling the cream before churning were similar in all three cases. The limiting factor in the production of fishy flavor in butter seems to be in the apparent decomposition of one or more of the constituents of butter during the preparation of the cream before churning and this decomposition product is used as pabulum by bacteria. Lecithin, a constituent of butter, from its chemical constitution can be broken down to a compound which has the odor and flavor of decomposed fish. Bact. ichthyosmius may specifically utilize the decomposition products of lecithin and bring about the formation of tri-methylamine, the compound which tastes and smells like decomposed fish.

CONCLUSIONS

1. Fishy flavor was produced in butter by inoculating the cream with Bact. ichthyosmius.

2. The age of the cream, the acid content of the cream, and the period of incubation before churning seem to influence the production of fishy flavor in butter.

3. Decomposition products of lecithin apparently are used as pabulum by Bact. ichthyosmius and the organism forms therefrom tri-methylamine giving fishy flavor to the butter.

The author wishes to express his thanks publicly to the Dairy Department for furnishing material for this problem and to Prof. W. A. Stocking for suggestions and aid in carrying out the work. Also to Professor E. S. Guthrie, Dr. G. C. Supplee, H. C. Jackson and W. E. Ayres for scoring the butter used in this problem.

REFERENCES

(1) HARDING, H. A., ROGERS, L. A., AND SMITH, G. A. 1900 N. Y. Agr. Experi. Sta., Geneva, Bul. 183, pp. 179–181.
(2) O'CALLAGHAN, M. A. 1901 Fishy flavored butter: The cause and remedy. The Agr. Gaz. N. S. Wales, xii, 341.
(3) REAKES, C. J., CUDDIE, D., AND REID, H. A. 1912 Jour. New Zeal. Dept. Agr., iv, no. 1, pp. 1–6.
(4) HARRISON, J. 1901 Fishy flavor in butter. N. Y. Produce Review and Am. Creamery, xiii, 20.
(5) ROGERS, L. A. 1909 Fishy flavor in butter. U. S. Dept. Agr. Bur. Animal Ind. Cir. 146.
(6) HUNZIKER, O. F. 1915 Report of Department of Dairy Husbandry. 28th Ann. Rpt. Purdue Univ. Exp. Sta., p. 39.
(7) HAMMER, B. W. 1917 Fishiness in evaporated milk. Iowa Agr. Exp. Sta. Research Bul. 38.

THE ELEVENTH ANNUAL STUDENTS' NATIONAL CONTEST IN JUDGING DAIRY CATTLE

HELMER RABILD

Dairy Division, Department of Agriculture, Washington, D. C.

Tne eleventh annual Students' National Contest in Judging Dairy Cattle was held at the National Dairy Show in Chicago, Illinois, October 6, 1919. The contest was open to teams of three men each, from all agricultural colleges. Teams from fifteen colleges participated in the contest. The states of Wisconsin, Indiana and South Carolina were represented for the first time.

Twelve animals of each of four dairy breeds were judged, namely, four bulls, four cows and four heifers; and the students were required to place these animals in their proper order of excellence. This placing was then compared with the official contest placing, which was determined by a committee consisting of coaches of the various teams.

DeLaval Scholarship ($400). The DeLaval scholarship offered by the DeLaval Separator Company was won by Mr. Roy W. Ingham of the University of Nebraska for doing the best work in judging all breeds.

Holstein-Friesian Scholarship ($400). The Holstein-Friesian scholarship offered by the Holstein-Friesian Association of America to the student standing highest in the judging of Holsteins was won by Mr. E. H. Taylor of the Massachusetts Agricultural College.

Jersey Scholarship ($400). The Jersey scholarship offered by the American Jersey Cattle Club to the student doing the best work in judging Jerseys was won by Mr. L. A. Jessup of Purdue University, Indiana.

The National Dairy Association Medals. The National Dairy Association awarded gold medals to the five highest, or sweepstakes, winners judging all breeds, as follows:

1. Roy W. Ingham.....University of Nebraska
2. David Gilkerson.....South Dakota Agricultural College
3. E. E. Gottman.....Kansas State Agricultural College
4. H. C. Cole.....University of Wisconsin
5. W. F. Dove.....Iowa State College

Official judges

Minnesota.....J. C. Cort
Wisconsin.....R. S. Hulce
Iowa,.....Carl Weaver
Nebraska.....B. H. Thompson
Kansas.....H. W. Cave
Missouri.....W. W. Swett
Indiana.....L. H. Fairchild
New York.....H. H. Wing
South Carolina.....W. W. Fitzpatrick
New Hampshire.....J. M. Fuller
Massachusetts.....J. C. McNutt
Washington.....E. G. Woodward
South Dakota.....H. Jones
Maryland.....D. Meade
Ohio.....C. T. Conklin

R. S. Hulce H. Jones

Winners of trophies and scholarships

Ayrshire Trophy.....New York State College
Guernsey Trophy.....Iowa State College
Holstein Trophy.....Kansas State Agricultural College
Jersey Trophy.....University of Missouri
Hoard's Dairyman Sweepstakes Trophy,
Kansas State Agricultural College
National Dairy Show Sweepstakes Trophy,
Kansas State Agricultural College
J. B. Ford Company Cup.....South Dakota State College
Holstein Scholarship, E. H. Taylor, Massachusetts Agricultural College
Jersey Scholarship.....L. A. Jessup, Purdue University, Indiana
DeLaval Scholarship.....Roy Ingham, University of Nebraska

Report of teams in judging all breeds

Basis of award of { National Dairy Association cup / *Hoard's Dairyman* cup

2. J. B. Ford cup

RANK	TEAM	SCORE
1	Kansas State Agricultural College	210
2	South Dakota State College	232
3	Iowa State College	242 H. C.
4	University of Minnesota	242 L. C.
5	University of Nebraska	246
6	Washington State College	249
7	Ohio State University	268
8	Clemson Agricultural College	278
9	Purdue University	279
10	New York State College of Agriculture	282
11	University of Wisconsin	305
12	Massachusetts Agricultural College	316
13	Maryland State College	322
14	University of Missouri	331
15	New Hampshire College	337

Report of teams in judging Ayrshires

Ayrshire cup

1	New York State College	31
2	University of Minnesota	36
3	Washington State College	49
4	Massachusetts Agricultural College	55
5	Ohio State University	61
6	New Hampshire College	62
7	Kansas State Agricultural College	65
8	South Dakota State College	69
9	Clemson Agricultural College	72
10	University of Nebraska	75
11	University of Wisconsin	78
12	Purdue University	87
13	Maryland State College	90
14	Iowa State College	95
15	University of Missouri	111

Report of teams in judging Guernseys

Basis of award of Guernsey cup

RANK	TEAM	SCORE
1	Iowa State College	37
2	Washington State College	41
3	Purdue University	45
4	University of Minnesota	46
5	South Dakota State College	47
6	University of Wisconsin	54
7	Clemson Agricultural College	58
8	New York State College	59
9	University of Nebraska	65
10	Maryland State College	67
11	Kansas State Agricultural College	77
12	Ohio State University	100
13	University of Missouri	103
14	New Hampshire College	108
15	Massachusetts Agricultural College	128

Report of teams in judging Holsteins

Basis of award of Holstein-Friesian cup

1	Kansas State Agricultural College	20
2	Iowa State College	52
3	Ohio State University	55
4	South Dakota State College	57
5	University of Nebraska	58
6	Maryland State College	60
7	New Hampshire College	64
8	Massachusetts Agricultural College	72
9	New York State Agricultural College	74
10	Clemson Agricultural College	77
11	University of Missouri	84
12	Purdue University	87
13	Wisconsin University	88 H. C.
14	Washington State College	88 L. C.
15	University of Minnesota	99

Report of teams in judging Jerseys

Jersey cup

RANK	TEAM	SCORE
1	University of Missouri	33
2	University of Nebraska	48 H. C.
3	Kansas State Agricultural College	48 L. C.
4	Ohio State University	52
5	Iowa State College	58
6	Purdue University	60
7	Massachusetts Agricultural College	61 H. C.
8	University of Minnesota	61 L. C.
9	South Dakota Stage College	62
10	Clemson Agricultural College	70
11	Washington State College	71
12	University of Wisconsin	85
13	New Hampshire College	103
14	Maryland State College	105
15	New York State College of Agriculture	118

Report of individuals in judging all breeds

DeLaval separator scholarship and five gold medals

RANK	ENTRY NUMBER	NAME	COLLEGE	SCORE
1	6	Roy W. Ingham	University of Nebraska	32
2	44	David Gilkerson	South Dakota State College	44
3	28	E. E. Gottman	Kansas State Agricultural College	45
4	8	H. C. Cole	University of Wisconsin	59 H. C.
5	34	W. F. Dove	Iowa State College	59 L. C.
6	32	J. C. Knott	Washington State College	61
7	24	H. M. Kaldahl	University of Minnesota	64
8	20	L. A. Jessup	Purdue University	65
9	30	Raymond Campbell	Kansas State Agricultural College	69
10	37	E. H. Taylor	Massachusetts Agricultural College	71
11	40	W. M. McVey	Ohio State University	74
12	4	Don Q. Douglas	University of Nebraska	75
13	14	J. W. Beiermeister	New York State College of Agriculture	76
14	10	F. M. Allen	Clemson Agricultural College	77
15	31	Chas. Hansen	Washington State College	82
16	45	H. E. Urton	South Dakota State College	83
17	11	Thos. H. Burgess	Clemson Agricultural College	84
18	2	J. A. Gray	Maryland State College	86 H. C.
19	23	C. B. Finley	University of Minnesota	86 2d H. C.
20	42	E. D. Lenhart	Ohio State University	86 L. C.
21	35	L. A. Bent	Iowa State College	87
22	22	R. H. Steidl	University of Minnesota	91
23	7	Chas. B. Drewry	University of Wisconsin	93
24	29	G. C. Anderson	Kansas State Agricultural College	95
25	36	H. B. Davel	Iowa State College	96
26	16	H. J. Harling	New Hampshire College	101 H. C.
27	5	E. T. Itschner	University o Missouri	101 2d H. C.
28	15	Martin G. Beck	New York State College of Agriculture	101 L. C.
29	26	W. J. Keegan	University of Missouri	104
30	43	Bernard Iverson	South Dakota State College	105 H. C.
31	13	Francis J. Oates	New York State College of Agriculture	105 2d H. C.
32	19	J. M. Kirkpatrick	Purdue University	105 L. C.
33	33	H. O. Lisle	Washington State College	106
34	41	J. L. Hirsch	Ohio State University	108

Report of individuals in judging all breed—continued

RANK	ENTRY NUMBER	NAME	COLLEGE	SCORE
35	21	B. E. Sellers	Purdue University	109
36	3	W. C. Snarr	Maryland State College	114 H. C.
37	17	A. B. Brown	New Hampshire College	114 L. C.
38	12	S. A. McGee	Clemson Agricultural College	117 H. C.
39	39	E. E. Harvey	Massachusetts Agricultural College	117 L. C.
40	18	R. J. Young	New Hampshire College	122 H. C.
41	1	John R. Drawbaugh	Maryland State College	122 L. C.
42	27	John Crosser	University of Missouri	126
43	38	A. C. Williams	Massachusetts Agricultural College	128
44	5	P. B. Campbell	University of Nebraska	139
45	9	Sidney P. Murat	University of Wisconsin	153

Report of individuals in judging Ayrshires

1	23	C. B. Finley	University of Minnesota	22
2	30	Raymond Campbell	Kansas State Agricultural College	23
3	6	Roy W. Ingham	University of Nebraska	28 H. C.
4	44	David Gilkerson	South Dakota State College	28 L. C.
5	14	J. W. Beiermeister	New York State College of Agriculture	50
6	7	Charles B. Drewry	University of Wisconsin	65
7	3	W. C. Snarr	Maryland State College	70 H. C.
8	13	Francis J. Oates	New York State College of Agriculture	70 L. C.
9	22	R. H. Steidl	University of Minnesota	75 H. C.
10	39	E. E. Harvey	Massachusetts Agricultural College	75 L. C.
11	16	H. J. Harling	New Hampshire College	76
12	19	J. M. Kirkpatrick	Purdue University	79
13	11	Thomas H. Burgess	Clemson Agricultural College	83 H. C.
14	31	Chas. Hansen	Washington State College	83 L. C.
15	41	J. L. Hirsch	Ohio State University	84
16	33	H. O. Lisle	Washington State College	85
17	37	E. H. Taylor	Massachusetts Agricultural College	87
18	15	Martin G. Beck	New York State College of Agriculture	88
19	32	J. C. Knott	Washington State College	89

Report of individuals in judging Ayrshires—continued

RANK	ENTRY NUMBER	NAME	COLLEGE	SCORE
20	28	E. E. Gottman	Kansas State Agricultural College	90
21	18	R. J. Young	New Hampshire College	93
22	40	W. M. McVey	Ohio State University	94
23	10	F. M. Allen	Clemson Agricultural College	97 H. C.
24	42	E. D. Lenhart	Ohio State University	97 L. C.
25	34	W. F. Dove	Iowa State College	99 H. C.
26	24	H. M. Kaldahl	University of Minnesota	99 L. C.
27	45	H. E. Urton	South Dakota State College	100
28	38	A. C. Williams	Massachusetts Agricultural College	103 H. C.
29	35	L. A. Bent	Iowa State College	103 L. C.
30	17	A. B. Brown	New Hampshire College	104 H. C.
31	26	W. J. Keegan	University of Missouri	104 L. C.
32	5	P. B. Campbell	University of Nebraska	105 H. C.
33	20	L. A. Jessup	Purdue University	105 L. C.
34	9	Sidney P. Murat	University of Wisconsin	109 H. C.
35	27	John Crosser	University of Missouri	109 L. C.
36	43	Bernard Iverson	South Dakota State College	111
37	12	S. A. McGee	Clemson Agricultural College	117
38	8	H. C. Cole	University of Wisconsin	120
39	2	J. A. Gray	Maryland State College	127 H. C.
40	4	Don Q. Douglas	University of Nebraska	127 L. C.
41	36	H. B. Davel	Iowa State College	132
42	21	B. F. Sellers	Purdue University	135
43	29	G. C. Anderson	Kansas State Agricultural College	188
44	21	John R. Drawbaugh	Maryland State College	190
45	25	E. T. Itschner	University of Missouri	213

Report of individuals in judging Guernseys

1	32	J. C. Knott	Washington State College	23
2	11	Thos. H. Burgess	Clemson Agricultural College	28
3	8	H. C. Cole	University of Wisconsin	40
4	20	L. A. Jessup	Purdue University	44
5	28	E. E. Gottman	Kansas State Agricultural College	45
6	44	David Gilkerson	South Dakota State College	54
7	24	H. M. Kaldahl	University of Minnesota	55
8	15	Martin G. Beck	New York State College of Agriculture	62

Report of individuals in judging Guernseys—continued

RANK	ENTRY NUMBER	NAME	COLLEGE	SCORE
9	34	W. F. Dove	Iowa State College	65
10	2	J. A. Gray	Maryland State College	67 H. C.
11	6	Roy W. Ingham	University of Nebraska	67 L. C.
12	23	C. B. Finley	University of Minnesota	72
13	36	H. B. Davel	Iowa State College	77
14	31	Charles Hansen	Washington State College	79
15	35	L. A. Bent	Iowa State College	83
16	25	E. T. Itschner	University of Missouri	85
17	7	Chas. Drewry	University of Wisconsin	86
18	10	F. M. Allen	Clemson Agricultural College	87 H. C.
19	19	J. M. Kirkpatrick	Purdue University	87 L. C.
20	45	H. E. Urton	South Dakota State College	91 H. C.
21	43	Bernard Iverson	South Dakota State College	91 L. C.
22	21	B. F. Sellers	Purdue University	93
23	14	J. W. Beiermeister	New York State College of Agriculture	95
24	1	John R. Drawbaugh	Maryland State College	96
25	4	Don Q. Douglas	University of Nebraska	97 H. C.
26	33	H. O. Lisle	Washington State College	97 L. C.
27	22	R. H. Steidl	University of Minnesota	102 H. C.
28	13	Francis J. Oates	New York State College of Agriculture	102 L. C.
29	5	P. B. Campbell	University of Nebraska	105 H. C.
30	42	E. D. Lenhart	Ohio State University	105 L. C.
31	40	W. M. McVey	Ohio State University	108 H. C.
32	30	Raymond Campbell	Kansas State Agricultural College	108 2d H. C.
33	3	W. C. Snarr	Maryland State College	108 L. C.
34	9	Sidney P. Murat	University of Wisconsin	109
35	16	H. J. Harling	New Hampshire College	110 H. C.
36	17	A. B. Brown	New Hampshire College	110 L. C.
37	18	R. J. Young	New Hampshire College	116
38	12	S. A. McGee	Clemson Agricultural College	121
39	41	J. L. Hirsch	Ohio State University	122
40	29	G. C. Anderson	Kansas State Agricultural College	124
41	37	E. H. Taylor	Massachusetts Agricultural College	137
42	27	John Crosser	University of Missouri	156
43	39	E. E. Harvey	Massachusetts Agricultural College	157
44	38	A. C. Williams	Massachusetts Agricultural College	160
45	26	W. J. Keegan	University of Missouri	172

Report of individuals in judging Holsteins

Holstein scholarship

RANK	ENTRY NUMBER	NAME	COLLEGE	SCORE
1	37	E. H. Taylor	Massachusetts Agricultural College	37
2	28	E. E. Gottman	Kansas State Agricultural College	48
3	2	J. A. Gray	Maryland State College	49
4	29	G. C. Anderson	Kansas State Agricultural College	53
5	17	A. B. Brown	New Hampshire College	65
6	4	Don Q. Douglas	University of Nebraska	66 H. C.
7	36	H. B. Davel	Iowa State College	66 L. C.
8	14	J. W. Beiermeister	New York State College of Agriculture	67
9	8	H. C. Cole	University of Wisconsin	68
10	10	F. M. Allen	Clemson Agricultural College	71
11	44	David Gilkerson	South Dakota State College	75 H. C.
12	1	John R. Drawbaugh	Maryland State College	75 L. C.
13	6	Roy W. Ingham	University of Nebraska	79 H. C.
14	30	Raymond Campbell	Kansas State Agricultural College	79 L. C.
15	34	W. F. Dove	Iowa State College	80
16	42	E. D. Lenhart	Ohio State University	84 H. C.
17	21	B. F. Sellers	Purdue University	84 L. C.
18	40	W. M. McVey	Ohio State University	87 H. C.
19	18	R. J. Young	New Hampshire College	87 2d H. C.
20	24	H. M. Kaldahl	University of Minnesota	87 L. C.
21	41	J. L. Hirsch	Ohio State University	92
22	45	H. E. Urton	South Dakota State College	96
23	32	J. C. Knott	Washington State College	97
24	43	Bernard Iverson	South Dakota State College	97 L. C.
25	27	John Crosser	University of Missouri	99
26	26	W. J. Keegan	University of Missouri	101
27	20	L. A. Jessup	Purdue University	109
28	33	H. O. Lisle	Washington State College	113
29	38	A. C. Williams	Massachusetts Agricultural college	114
30	35	L. A .Bent	Iowa State College	115
31	11	Thomas H. Burgess	Clemson Agricultural College	119 H. C.
32	13	Francis J. Oates	New York State College of Agriculture	119 L. C.
33	25	E. T. Itschner	University of Missouri	124
34	15	Martin G. Beck	New York State College of Agriculture	125

Report of individuals in judging Holsteins—continued

RANK	ENTRY NUMBER	NAME	COLLEGE	SCORE
35	22	R. H. Steidl	University of Minnesota	129
36	12	S. A. McGee	Clemson Agricultural College	133
37	31	Charles Hansen	Washington State College	142
38	7	Charles B. Drewry	University of Wisconsin	145 H. C.
39	5	P. B. Campbell	University of Nebraska	145 L. C.
40	16	H. J. Harling	New Hampshire College	146
41	9	Sidney P. Murat	University of Wisconsin	148
42	39	E. E. Harvey	Massachusetts Agricultural College	154
43	19	J. M. Kirkpatrick	Purdue University	156
44	23	C. B. Finley	University of Minnesota	166
45	3	W. C. Snarr	Maryland State College	175

Report of individuals judging Jerseys

Jersey scholarship

1	20	L. A. Jessup	Purdue University	25
2	26	W. J. Keegan	University of Missouri	40
3	40	W. M. McVey	Ohio State University	41
4	4	Don Q. Douglas	University of Nebraska	47
5	6	Roy W. Ingham	University of Nebraska	49 H. C.
6	12	S. A. McGee	Clemson Agricultural College	49 L. C.
7	25	E. T. Itschner	University of Missouri	52
8	29	G. C. Anderson	Kansas State Agricultural College	53
9	8	H. C. Cole	University of Wisconsin	54 H. C.
10	34	W. F. Dove	Iowa State College	54 L. C.
11	24	H. M. Kaldahl	University of Minnesota	64
12	37	E. H. Taylor	Massachusetts Agricultural College	67
13	35	L. A. Bent	Iowa State College	73
14	45	H. E. Urton	South Dakota State College	77
15	16	H. J. Harling	New Hampshire College	79
16	42	E. D. Lenhart	Ohio State University	81
17	31	Chas. Hansen	Washington State College	84
18	32	J. C. Knott	Washington State College	85 H. C.
19	28	E. E. Gottman	Kansas State Agricultural College	85 L. C.
20	22	R. H. Steidl	University of Minnesota	87
21	30	Raymond Campbell	Kansas State Agricultural College	90

Report of individuals judging Jerseys—continued

RANK	ENTRY NUMBER	NAME	COLLEGE	SCORE
22	39	E. E. Harvey	Massachusetts Agricultural College	91
23	44	David Gilkerson	South Dakota State College	95
24	27	John Crosser	University of Missouri	101 H. C.
25	43	Bernard Iverson	South Dakota State College	101 L. C.
26	10	F. M. Allen	Clemson Agricultural College	102
27	38	A. C. Williams	Massachusetts Agricultural College	104
28	21	B. F. Sellers	Purdue University	105
29	3	W. C. Snarr	Maryland State College	110 H. C.
30	23	C. B. Finley	University of Minnesota	110 L. C.
31	19	J. M. Kirkpatrick	Purdue University	114
32	7	Chas. B. Drewry	University of Wisconsin	117
33	41	J. L. Hirsch	Ohio State University	121
34	2	J. A. Gray	Maryland State College	124
35	36	H. B. Davel	Iowa State College	125
36	33	H. O. Lisle	Washington State College	130
37	13	Francis J. Oates	New York State College of Agriculture	142
38	11	Thomas H. Burgess	Clemson Agricultural College	153 H. C.
39	5	P. B. Campbell	University of Nebraska	153 L. C.
40	14	J. W. Beiermeister	New York State College of Agriculture	155
41	15	Martin G. Beck	New York State College of Agriculture	161
42	1	John R. Drawbaugh	Maryland State College	164
43	17	A. B. Brown	New Hampshire Collge	165
44	9	Sidney P. Murat	University of Wisconsin	184
45	18	R. J. Young	New Hampshire College	185

Contestants' numbers by colleges

NUMBER	NAME	COLLEGE
N 1	John R. Drawbaugh	Maryland State College
O 2	J. A. Gray	Maryland State College
P 3	W. C. Snarr	Maryland State College
Q 4	Don Q. Douglas	University of Nebraska
N 5	P. B. Campbell	University of Nebraska
O 6	Roy W. Ingham	University of Nebraska
P 7	Charles B. Drewry	University of Wisconsin
Q 8	H. C. Cole	University of Wisconsin
N 9	Sidney P. Murat	University of Wisconsin
O 10	F. M. Allen	Clemson Agricultural College
P 11	Thomas H. Burgess	Clemson Agricultural College
Q 12	S. A. McGee	Clemson Agricultural College
N 13	Francis J. Oates	New York State College of Agriculture
O 14	J. W. Beiermeister	New York State College of Agriculture
P 15	Martin G. Beck	New York State College of Agriculture
Q 16	H. J. Harling	New Hampshire College
N 17	A. B. Brown	New Hampshire College
O 18	R. J. Young	New Hampshire College
P 19	J. M. Kirkpatrick	Purdue University
Q 20	L. A. Jessup	Purdue University
N 21	B. F. Sellers	Purdue University
O 22	R. H. Steidl	University of Minnesota
P 23	C. B. Finley	University of Minnesota
Q 24	H. M. Kaldahl	University of Minnesota
N 25	E. T. Itschner	University of Missouri
O 26	W. J. Keegan	University of Missouri
P 27	John Crosser	University of Missouri
Q 28	E. E. Gottman	Kansas State Agricultural College
N 29	G. C. Anderson	Kansas State Agricultural College
O 30	Raymond Campbell	Kansas State Agricultural College
P 31	Charles Hansen	Washington State College
Q 32	J. C. Knott	Washington State College
N 33	H. O. Lisle	Washington State College

Contestants' numbers by colleges—continued

NUMBER	NAME	COLLEGE
O 34	W. F. Dove	Iowa State College
P 35	L. A. Bent	Iowa State College
Q 36	H. B. Davel	Iowa State College
N 37	E. H. Taylor	Massachusetts Agricultural College
O 38	A. C. Williams	Massachusetts Agricultural College
P 39	E. E. Harvey	Massachusetts Agricultural College
Q 40	W. M. McVey	Ohio State University
N 41	J. L. Hirsch	Ohio State University
O 42	E. D. Lenhart	Ohio State University
P 43	Bernard Iverson	South Dakota State College
Q 44	David Gilkerson	South Dakota State College
N 45	H. E. Urton	South Dakota State College

A PRELIMINARY REPORT ON THE STUDY OF THE TEMPERATURES AT WHICH MILK OF DIFFERENT PER CENTS OF ACIDITY WILL COAGULATE

T. J. McINERNEY

Department of Dairy Industry, Cornell University, Ithaca, New York

According to Hammersten[1] "perfectly fresh amphoteric milk does not coagulate on boiling but forms a pellicle consisting of casein and lime-salts which rapidly reforms after being removed. Even after passing a current of carbon dioxide through the fresh milk it does not coagulate on boiling. In proportion as the formation of lactic acid advances this behavior changes and soon a stage is reached when the milk, which has previously had carbonic acid passed through it, coagulates on boiling. At a second stage it coagulates alone on heating, thus it coagulates by passing carbon dioxide alone without boiling; and lastly when the formation of lactic acid is sufficient, it coagulates spontaneously at the ordinary temperature forming a solid mass. It may also happen especially in the warmth, that the casein clot contracts and a yellowish or yellowish green acid liquid (acid whey) separates."

According to Van Slyke, "when milk is treated with acid or acid salts the casein is precipitated as a heavy, white solid in more or less flocculent form, depending on conditions of treatment. When milk sours in the ordinary way the lactic acid that is formed produces the same effect as the addition of any dilute acid; the precipitation or curdling occurs at ordinary temperatures, when the acidity reaches 0.6 to 0.7 per cent expressed as lactic acid. When dilute artificial lactic acid is added directly to fresh milk, precipitation takes place at ordinary room temperature when the acidity reaches 0.57 per cent. Increase of temperature enables a smaller amount of acid to precipitate casein; for example, milk curdling at room tempera-

[1] A Text Book of Physiological Chemistry. Hammerstein and Mandel. From Allen's Commercial Organic Analysis, vol. viii, p. 121.

ture with 0.55 per cent of added lactic acid, precipitates with 0.35 per cent at boiling temperature, according to work done in the laboratory of the writer." The indicator used in determining milk acidity is phenolphthalein. Litmus cannot be used because of the amphoteric reaction of fresh milk. Hörner gives the following method of determining the acidity of milk.[2] Ten cubic centimeters of milk are diluted with 20 cc. of water a few drops of a dilute alcoholic solution of phenolphthalein added and the titration made with $\frac{N}{10}$ alkali. Hörner proposes that the number of cubic centimeter required should be multiplied by 10 and the result termed the "degree of acidity." Fresh normal milk will show figures ranging from 16 to 18. When the degree of acidity is 23 or more, the sample will coagulate on heating.

Owing to the fact that modern methods of handling milk and its products frequently involves heating to a temperature of 145°F. or higher, it seemed desirable to secure further information regarding the relation between the percentage of acidity, the temperature and coagulation. For this purpose the following experiments were performed.

PRELIMINARY WORK

Eighteen grams of milk were titrated with $\frac{N}{10}$ alkali solution using phenolphthalein as an indicator, the purpose being to determine the "degree" or per cent acidity of the milk. To another 18 gram sample of milk was added 100 cc. of distilled water. A solution of $\frac{N}{10}$ lactic acid was then added until the curd was precipitated or the milk coagulated and the temperature was noted.

To a third sample was added 100 cc. of distilled water and a smaller volume of acid. The mixture of milk, water and acid was then heated until the milk coagulated and the temperature noted. This was continued for several per cents of acid and several temperatures. The method may be illustrated as follows: 18 gram milk + 100 cc. distilled water + 48 cc. of $\frac{N}{10}$ lactic acid precipitated at 60°F.

[2] Chem. Zeit. 1892, 16, 1479, 1519.

Another method was to heat the mixture of 18 grams of milk and 100 cc. of distilled water to a given temperature and then add the $\frac{N}{10}$ lactic acid solution until the milk curdled. In these experiments it was found that the milk when heated before adding the acid curdled at a lower temperature than was the case when the acid was first added and the mixture heated. The only explanation for this is that the acid on coming in contact with the warm milk may coagulate the part of the milk with which it comes in contact and the coagulation may not be uniform. In the other case when the acid is added to the milk before heating, the acid is evenly distributed through the milk and when the critical temperature is reached the entire mass of milk will coagulate. Later in the work it was found best to take 100 cc. portions of milk after the acid test had been made and add a certain amount of the $\frac{N}{10}$ lactic acid. The mixture of milk and acid was then heated in a steam bath until the milk coagulated and the temperature was noted. The amount of acid varied from the amount required to coagulate the milk at room temperature to 180°F. Usually the difference in amount added each time was about 5 cc.

Over 200 samples of milk have been treated by the above methods and the figures given below are indicative of the results obtained.

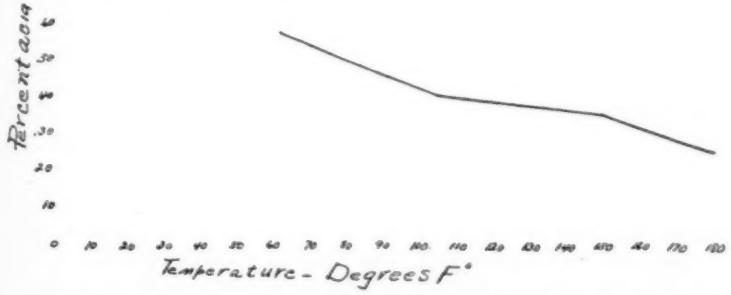
	AMOUNT OF MILK	ACID	TEMPERATURE
Experiment I			
	cc.	*per cent*	*°F.*
Skim milk; 0.145 per cent acid.....	100	0.580	70
	100	0.480	104
	100	0.430	145
	100	0.390	150
	100	0.340	155
	100	0.280	170
	100	0.250	185
Experiment II			
Skim milk; 0.14 per cent acid	100	0.570	68
	100	0.54	66

	AMOUNT OF MILK	ACID	TEMPERATURE
Experiment III			
Skim milk; 0.23 per cent acid	100	0.520	74
Experiment IV			
Whole milk; 0.15 per cent acid	100	0.550	66
	100	0.410	105
	100	0.367	150
	100	0.320	157
Experiment V			
Skim milk; 0.17 per cent acid	100	0.520	74
	100	0.470	85
	100	0.430	125
	100	0.390	140
	100	0.340	157
	100	0.300	180
	100	0.260	195
Experiment VI			
Pasteurized milk (24 hours old), 0.18 per cent acid	100	0.480	67
	100	0.440	82
	100	0.398	100
	100	0.350	155
	100	0.310	165
	100	0.269	182
	100	0.220	200
Experiment VII			
	cc.	*per cent*	°*F.*
Pasteurized milk (24 hours old); 0.15 per cent acid	100	0.560	66
	100	0.500	85
	100	0.480	83
	100	0.450	95
	100	0.410	96
	100	0.400	104
	100	0.390	110
	100	0.370	140
	100	0.360	150
	100	0.320	160

	AMOUNT OF MILK	ACID	TEMPERATURE
Experiment VIII			
Whole milk; 0.14 per cent acid.....	100	0.530	73
	100	0.480	87
	100	0.440	110
	100	0.400	110
	100	0.350	147
	100	0.310	162
	100	0.270	175
Experiment IX			
Milk (24 hours old).....	100	0.500	76
	100	0.450	88
	100	0.400	100
	100	0.360	105
	100	0.340	153
	100	0.330	158
Experiment X			
Whole milk; 0.15 per cent acid.....	100	0.540	68
	100	0.495	72
	100	0.466	88
	100	0.440	96
	100	0.420	105
	100	0.397	150
	100	0.375	155
	100	0.330	160
	100	0.285	173
Experiment XI			
Whole milk; 0.40 per cent acid.....	100	0.527	67
	100	0.490	70
	100	0.472	74
	100	0.445	86
	100	0.427	88
	100	0.409	100
	100	0.400	110

These experiments show that milk containing 0.57 per cent acid (in terms of lactic acid) will, on the average, precipitate at a temperature between 60° to 65°F. Milk containing 0.50 per cent acid will curdle at 75° to 80°F., 0.40 per cent at 100° to

110°F., 0.35 per cent at about 150°F. and 0.25 per cent acid in milk will not cause coagulation until heated to 180°F. As shown in the curve, the small drop in acidity between 0.40 to 0.35 per cent makes a greater range of temperature than between any other two points of acidity studied. As shown in the experiments, a decrease of 0.05 per cent acid at this particular stage requires nearly a 50°F. range in temperature to produce coagulation as 0.40 per cent acid in milk will curdle at about 100°F. while 0.35 per cent acid in milk will not produce curdling until heated to at least 150°F.



CURVE SHOWING THE TEMPERATURE AT WHICH MILK OF DIFFERENT PER CENTS OF ACID WILL COAGULATE

The author believes that, when the milk is heated to about 100°F., a chemical change may take place in the calcium salts found in milk and in some way cause the casein to be held in suspension.

The addition of di-sodium phosphate will retard the precipitation of the curd in milk even though a high percentage of lactic acid is present. As an illustration, a sample of milk showing 0.60 per cent acid curdled when heated to 60°F. Another 18 gram sample of this milk was taken to which was added 20 cc. of 1 per cent solution of di-sodium phosphate (Na_2HPo_4) and this sample of milk did not precipitate when heated to 175°F.

The addition of mono-calcium phosphate $CaH_4(Po_4)2$ has an entirely different effect than the sodium phosphate. The former will hasten the coagulation of milk as illustrated in the following

experiment. Twenty cubic centimeters of skim milk containing 0.18 per cent acid was used in the experiment. To this was added 44 cc. of a 1 per cent solution of mono-calcium phosphate (CaH_4) $(Po_4)2$ and the sample curdled at 70°F. The result of these experiments would tend to show that the break in the curve, which is formed with the different per cents of acid and different temperatures may be due to the phosphates in milk.

Further study is being made as to the exact cause of the irregular curve produced from the above experiments.

A NOTE ON THE ACIDITY OF FRESH MILK

T. J. McINERNEY

Department of Dairy Industry, Cornell University, Ithaca, New York

When milk is first drawn from the cow's udder it gives what is known as an amphoteric reaction, that is it turns red litmus paper blue and blue litmus paper red. In spite of this fact fresh milk is rarely alkaline and is always acid toward phenolphthalein as an indicator.

Dairy chemists mention two kinds of acidity in milk; apparent acidity and real acidity. The real acidity of milk is due to lactic acid. This is never found in milk when it is first drawn from the udder. It is produced by the action of the lactic acid organisms on the milk sugar.

The so-called apparent acidity of milk is what gives fresh milk its acid reaction. It is now generally believed to be due to the presence of the carbon dioxide, acid phosphates and casein, all of which are found in fresh milk and which have an acid.

About a year ago the writer tested two samples of milk that were brought to this department. This milk had been rejected at the local condensary because of high acidity. Both samples showed 0.21 per cent acidity when tested by the usual alkali solution. The writer was then requested to visit the farm on which this milk was produced and test the milk from each individual cow. Samples were taken and tested for acidity immediately, and the remainder taken to the laboratory from which chemical analyses were made for total solids, fat, solids not fat and ash. The results are as follows:

COW NUMBER	ACIDITY	TOTAL SOLIDS	FAT	SOLIDS NOT FAT	ASH
1	0.202	15.83	6.0	9.83	0.907
2	0.185	15.68	6.5	9.18	0.805
3	0.175	16.91	7.5	9.41	0.775
4	0.205	15.29	5.9	9.39	0.841
5	0.202	15.55	5.9	9.65	0.733
Herd	0.190	15.78	6.3	9.48	0.820

These were all grade Jersey cows. From the tests made of the milk immediately after milking, it would indicate that nearly all the cows were giving milk showing a high per cent of acidity as shown by the alkali test. All these samples show a very high percentage of total solids, fat and solids not fat. The per cent of ash in all cases is higher than the average of normal milk, and in one or two cases the percentage of ash is exceedingly high. These facts would tend to show the reason for the high apparent acidity in the fresh milk.

To make a more complete study of the acidity in fresh milk, it was decided to determine the acidity of the milk of the different cows of the University herd. This herd was selected because five different breeds of cattle were represented and the age of the cow and the period of lactation of each individual animal was known. The breeds that were available for study were the Holstein, Shorthorn, Ayrshire, Guernsey and Jersey. There were 15 Holstein, 10 Jersey, 6 Guernsey, 5 Ayrshire, and 5 Shorthorns, making a total of 42 tests in all, or one from each cow. The samples were obtained immediately after the night milking and tests for acidity were made in about one-half hour after the samples were drawn.

The average per cent of acidity as shown by the alkali test for each breed in the herd and the highest and lowest per cents of acidity found in the milk of each breed are shown in the following table:

BREED	AVERAGE PER CENT ACID	HIGHEST PER CENT FOUND	LOWEST PER CENT FOUND
Holstein	0.136	0.180	0.100
Jersey	0.162	0.220	0.130
Guernsey	0.139	0.160	0.120
Ayrshire	0.123	0.150	0.105
Short Horn	0.180	0.200	0.165

The results from the data given above may be summarized as follows:

1. The per cent of apparent acid found in the fresh milk varied from 0.10 to 0.22 per cent.

2. There appears to be no relation between the period of lactation and the percentage of apparent acid in the milk.

3. There appears to be no relation between the age of the cow and the percentage of apparent acid found in the milk.

4. The kinds of feed had no effect on the percentage of acid found in the milk.

5. Fresh milk which showed a high percentage of solids not fat and a high percentage of ash showed a high percentage of apparent acidity.

6. Fresh milk comparatively low in solids not fat and in ash showed a lower percentage of apparent acidity.

OPEN FORUM

A Score Card for City Ice Cream Plants[1]—F. W. Fabian

The output of the ice cream industry has greatly increased in the last decade and likewise its commercial value. We now recognize it as one of the many American industries. But while the output and value have greatly increased, the sanitary measures have not kept pace with the industry. In some places possibly they have kept pace and in others they have not. One thing is certain that on the whole the ice cream industry has not received as much attention from a sanitary point of view as some of its sister industries. For example, in most cities, we do not find any bacteriological standard for ice cream or the constituents that go into its make up. We do not have a score card for city ice cream plants as we do for city milk plants. Cities in which there is a system of country and city milk inspection, we find no provision for inspection of ice cream plants or the farms supplying the cream and milk for ice cream. Many cities realizing the great need of sanitary inspection are taking steps to provide for this inspection.

It was while working for the Detroit Board of Health at Detroit, Michigan, in the summer of 1917 in the capacity of a sanitary inspector for ice cream plants, that my attention was called to the need of two things: First, regular sanitary inspection of all places large or small manufacturing ice cream, and second, a systematic way of recording the inspection.

Inquiry was then made of the Bureau of Animal Industry as to whether they knew of a score card for ice cream plants and they replied that they had never issued such a score card and knew of none, unless, the Louisiana State Board of Health issued one. Upon writing to them and having them forward a copy of their score card it was found that it was not a score card at all but simply a memorandum card upon which the inspector made general notations of the sanitary condition of the place, but it was a step in the right direction, however, and a great improvement upon no score card.

[1] Through an error, part of the score card was omitted from the article which was published in the November issue. In justice to the author, the entire article is reprinted in this issue.—Editor.

I am sure that no one familiar with the situation would doubt the need of regular sanitary inspection by a competent inspector. Here we have a plant manufacturing a product which is easily contaminated, and quite frequently is being handled by employees who are ignorant of the dangers that they may introduce by their ignorance and carelessness.

Now if this product were fed to cattle or utilized in any other way than it is, our problem would cease to exist; but since it is included in the human diet and occupies such a prominent place, it certainly needs careful sanitary supervision and inspection. Ice cream is not only used quite extensively in the normal healthy human diet, but is often recommended by physicians for the young, the old and convalescents alike. The same physician who would hesitate to recommend anything but certified milk (or some milk equally dependable) with a bacteria count of 10,000 or less, does not hesitate to recommend ice cream with no bacteria standard whatever, but which usually ranges from 10,000 to 1,000,000,000 bacteria per cubic centimeter.

The fact that ice cream is frozen seems to cover a multitude of sins in the layman's mind. Just as the farmer and most other people believe that straining and clarifying make dirty milk clean, likewise people believe that freezing kills all bacteria. All of these facts argue very strongly for regular sanitary inspection.

The duties of an inspector of ice cream plants, as in the case of any other sanitary inspector, are many. If he educates one man one way, advises another in another way, and assists the others in other ways, the sum total of his labors are varied and his efforts result in confusion. The best way to help all and secure uniform results is by the score card. In this way there is an outline to guide him and he can accord to all the same help and treatment.

The score card for ice cream plants as it is arranged here follows in general outline the score cards for city milk plants as approved by the United States Department of Agriculture, but is arranged to meet the needs of city ice cream plants. The ice cream plant is scored on the basis of 100 per cent as perfect, 40 per cent for equipment, and 60 per cent for methods.

The sanitary location of the building is the first consideration. Next comes the arrangement of the building providing a separate room for each major operation. The construction of the rooms and other sanitary considerations as drainage, light, pure air, screens, etc., are next taken up. The apparatus necessary for keeping the machinery and

utensils clean and sanitary, also the apparatus for handling ice cream in a sanitary way, together with the condition of the machinery are given consideration. Laboratory and equipment are also taken into account as well as the water supply.

The sanitary methods are considered from the viewpoint of the cleanliness of the building, such as floors, walls etc. The cleanliness and protection from contamination of the apparatus used in making, handling and storing the ice cream both before and after making are given consideration. The way in which the constituents used in making the ice cream are received, protected and cared for before they are used for ice cream is given a very prominent place. The score card makes it possible for the man who goes to the trouble and expense of installing a pasteurizer to get a better score than the man who does not. There are many arguments pro and con in regard to pasteurization of the constituents of ice cream but there certainly is no question as to the ultimate outcome of the matter. The time is not far distant when all cities shall require the constituents of ice cream to be pasteurized. A place is given to the wrapping of brick ice cream which is often wrapped in a very unsanitary way. Storage and protection during delivery are likewise given a place. The bacteriological analysis of both raw materials and the finished product as well as the inspection of the dairies supplying cream are included under the head of inspection. This should help to produce a purer product. Then under "miscellaneous" comes the cleanliness of attendants and provision for medical inspection, thus helping to decrease the possibility of pathogenic organisms in the final product after all other precautions have been taken. Finally, comes the sanitary outfit to carry a sanitary product to its destination, provided all the other provisions in the score card have been lived up to.

The score card follows:

BOARD OF HEALTH

SANITARY INSPECTION OF CITY ICE CREAM PLANTS

SCORE CARD

Owner or manager.....
Street and No.....
City.....State.....
Trade name.....
Number of wagons.....Gallons sold daily { Bulk ice cream..... / Brick ice cream.....
Permit or License No.....
Date of inspection.....192
Remarks...
.....
.....
.....
.....
.....
.....
.....Inspector.

Arranged by F. W. Fabian, Michigan Agricultural College, Department of Bacteriology and Hygiene, East Lansing, Michigan.

EQUIPMENT		SCORE	
		Perfect	Allowed
Building:			
Location:			
Sanitary surroundings		2	.....
Arrangement		9	
Separate receiving room	1		
Separate freezing room	2		
Separate mixing room	2		
Separate wash room	1		
Separate sales room	1		
Separate boiler room	1		
Separate refrigerator room	1		
Construction		12	.....
Floors, tight, sound, cleanable	2		
Walls, tight, smooth, cleanable	1		
Ceilings, smooth, tight, cleanable	1		
Drainage	2		
Floors	1		
Sewer or septic tank	1		
Provision for light	2		
(10) per cent of floor space).			
Provision for pure air	2		
Screens (windows, doors)	1		
Minimum of shafting, pulleys, hangers, exposed pipes, etc	1		
Apparatus		13	.....
Boiler	2		
(Water heater, 1)			
Appliances for cleansing utensils and cans	1		
Sterilizers for cans, etc	2		
Wrapping machine (brick ice cream)	2		
Clean table for hand wrapping	1		
Wash bowl, soap, and towel in handling room	1		
Condition	4		
Ice cream freezing and mixing machinery	2		
Pipes, couplings, and pumps	1		
Cans and containers	1		
Laboratory and equipment		2	.....
Water supply		2	.....
Clean and fresh	1		
Convenient and abundant	1		
Total		40	.....

METHODS		SCORE	
		Perfect	Allowed
Building		14	
Cleanliness:			
Floors	3		
Walls	2		
Ceilings	2		
Doors and windows	1		
Shafting, pulleys, pipes, etc	1		
Freedom from odors	2		
Freedom from flies	3		
Apparatus		7	
Cleanliness:			
Thoroughly washed and rinsed	3		
Machinery handling mix	2		
Pipes, cans, etc	1		
Sterilized with live steam	3		
Machinery handling mix	2		
Pipes, cans, etc	1		
Protected from contamination	1		
Ice cream containers		7	
Thoroughly washed and rinsed	3		
Sterilized with steam 15 minutes	3		
Inverted in clean place	1		
Handling cream, milk, etc		21	
Received below 50°F.	3		
(50°F. to 55°F. 2)			
(55°F. to 60°F. 1)			
Freedom from undue exposure to air	1		
Cooling	4		
Promptness	2		
Below 45°F	2		
Pasteurization of raw materials at 145°F. for 30 min. and promptly cooled to 45°F. or below	4		
Bricks wrapped by machine	2		
(Bricks wrapped by hand, 1)			
Ice cream container protected by cover	1		
Storage of ice cream at 0°F.	4		
(0°F. to 5°F. 3: 5°F. to 10°F. 1)			
Protection during delivery	2		
(Iced during entire year)			
Inspection		6	
Bacteriological work	3		
(Raw materials, 1, Finished product 2)			
Inspection of dairies supplying cream	3		
(2 times a year, 2; once a year, 1)			
Miscellaneous		5	
Cleanliness of attendants	2		
(Personal cleanliness, 1; clean, washable clothing, 1).			
Medical inspection of employees handling products	1		
Cleanliness of delivery outfit	2		
Total		60	

COMMITTEE APPOINTMENTS FOR THE AMERICAN DAIRY SCIENCE ASSOCIATION FOR 1920*

Dairy Farm Score Card

ERNEST KELLY, *Chairman*
C. B. LANE
H. A. HARDING
W. A. STOCKING
I. C. WELD
P. M. BRANDT

Milk Quality

H. A. HARDING, *Chairman*
W. A. STOCKING
J. D. BREW
R. S. BREED
E.G. HASTINGS
F. RASMUSSEN

Bacteriological Methods for Market Milk

R. S. BREED, *Chairman*
L. A. ROGERS
E. G. HASTINGS
B. W. HAMMER
J. D. BREW

Relation to Breed Associations

C. H. ECKLES, *Chairman*
H. H. WING
ROY T. HARRIS
E. G. WOODWARD
W. W. YAPP
G. C. WHITE
H. H. KILDEE

Methods Conducting Student Dairy Cattle Judging Contest

HELMER RABILD, *Chairman*
H. H. WING
WILLIAM REGAN
E. L. ANTHONY
H. H. KILDEE
J. B. FITCH
W. W. SWEET

Official Methods for Testing Milk and Cream for Butter Fat

O. F. HUNZIKER, *Chairman*
F. W. BOUSKA
FRED RASMUSSEN
H. C. TROY
L. A. ROGERS

Legal Standards for Butter

E. S. GUTHRIE, *Chairman*
S. C. THOMPSON
G. H. BENKENDORF
C. L. ROADHOUSE
F. W. BOUSKA

* This is a complete list of committee appointments as just received from President Mortimer.—EDITOR.

Statistics on Production and Marketing of Dairy Products

ROY C. POTTS, *Chairman*
O. F. HUNZIKER
S. C. THOMPSON
C. E. LEE
L. M. DAVIS

Graduate Instruction in Dairying

W. A. STOCKING, *Chairman*
R. A. PEARSON
C. W. LARSON
H. A. HARDING
C. H. ECKLES
E. G. HASTINGS

Courses of Instruction for Dairy Inspectors

A. C. ANDERSON, *Chairman*
H. E. VAN NORMAN
C. E. REED
I. C. WELD
J. A. GAMBLE
ERNEST KELLY

Feeding Standards for Milk Production

C. LARSON, *Chairman*
C. H. ECKLES
HELMER RABILD
A. C. RAGSDALE
A. A. BORLAND
E. S. SAVAGE
C. C. HAYDEN
H. P. DAVIS

Score Cards for Dairy Products

J. H. FRANDSEN, *Chairman*
H. B. ELLENBERGER
S. C. THOMPSON
B. W. HAMMER
L. A. ROGERS
ERNEST KELLY
W. P. B. LOCKWOOD
W. W. FISK
J. L. SAMMIS
O. F. HUNZIKER
J. A. GAMBLE

Methods for Conducting Student Dairy Products Judging Contest

WILLIAM WHITE, *Chairman*
W. P. B. LOCKWOOD
A. W. RUDNICK
E. S. GUTHRIE
J. H. FRANDSEN
H. F. JUDKINS
S. C. THOMPSON

State and National Brands for Butter and Cheese

W. W. FISK, *Chairman*
C. E. LEE
A. W. RUDNICK
C. LARSEN
N. W. HEPBURN
N. D. CHAPPELL

Cream Grading

J. H. FRANDSEN, *Chairman*
F. W. BOUSKA
GEORGE B. CAINE
G. S. HINE
C. W. LARSEN
J. A. CLUTTER
G. L. MARTIN

Legal Standards for Ice Cream

H. A. Rubbr, *Chairman* — E. F. Goss
R. M. Washburn — W. W. Fisk
O. F. Hunziker

Official Methods for Testing Butter for Butter Fat

H. C. Troy, *Chairman* — C. E. Gray
R. H. Shaw

Cost of Production

Oscar Erf, *Chairman* — G. F. Warren
F. A. Pearson — A. C. Anderson
Ernest Kelly

Constitution and By-Laws

C. H. Eckles, *Chairman* — W. J. Fraser
Fred Rasmussen — R. A. Pearson
O. F. Hunziker — J. H. Frandsen
M. Mortensen

DAIRY NOTES

J. W. HENDRICKSON
University of Nebraska

The Dairy Division at Washington, D. C., gives a report of the following changes:

Mr. C. J. Babcock, assistant market milk specialist, has been reappointed in the Dairy Division and has been assigned to dairy sanitation investigations in the market milk section. Mr. Babcock is a graduate of Ohio State University.

Dr. N. R. Blatherwick, who has been engaged on investigations in the physiology of milk secretion since 1915, conducted by this Division at its dairy farm at Beltsville, Maryland, has resigned to take charge of a research laboratory at Santa Barbara, California, which is being conducted in connection with a hospital where studies are being made of nutrition diseases, under the auspices of the Rockefeller Institute.

Mr. P. A. Clemmer, who has been engaged in bacteriological investigations of milk since 1915, has resigned to go into business in Pennsylvania.

Mr. L. B. Cook, market milk specialist since 1912, who has recently conducted milk sanitation investigations in the vicinity of Grove City, Pennsylvania, has resigned to accept the position of manager of a milk plant in Kane, Pennsylvania.

Mr. A. O. Dahlberg, dairy manufacturing specialist since 1912, engaged in research problems in dairy manufacture, has resigned to accept a position with the California Central Creameries.

Mr. C. S. Leets, assistant market milk specialist since 1917, has resigned to accept a position as field agent and inspector for the New Orleans Pure Milk Company, New Orleans, Louisiana.

Mr. R. J. Posson, market milk specialist, has been transferred from the Washington office to the Dairy Division office at Salt Lake City, to take the place of C. F. Hoyt, resigned. Mr. Posson will carry on the market milk work in the western states, which deals principally with the California State Department of Agriculture at Sacramento.

Mr. Geo. B. Taylor, market milk specialist of the Dairy Division since 1915, has resigned to accept the position of chemist and bacteriologist with Geo. M. Oyster's "Chestnut Farms Dairy," Washington, D. C.

Mr. P. A. Campbell, has been appointed for dairy extension work in the State of Connecticut, conducted coöperatively by the Dairy Division, United States Department of Agriculture, and the extension department, Storrs, Agricultural College, Storrs, Connecticut. Mr Campbell received his B. S. degree from New Hampshire State College, and his Master's degree from Iowa State College. He served as professor of animal husbandry, University of Maine, 1905–1913; as manager of Hillside Dairy Company, Dixville Notch, New Hampshire; and recently was manager of Ayredale Stock Farm, Bangor, Maine.

We are pleased to report that Prof. C. L. Roadhouse of the department of dairy industry, University of California, has under process of erection a fine new dairy building which will when completed add much to the efficiency of both the teaching and the experimental work to be carried on at that institution.

Professor Roadhouse also reports some changes that have taken place in his staff of co-workers.

Mr. S. L. Denning, instructor in the dairy industry division at the University of California, resigned in January to take a position with the Premier Machinery Company, San Francisco, California.

Mr. H. S. Baird, assistant professor of dairy industry, University of California, has a leave of absence, and has taken a position as superintendent of manufacture with the Northern California Milk Producers Association at Sacramento, California.

Mr. G. D. Turnbow, formerly dairy extension specialist at University of Wyoming, has accepted a position as assistant professor of dairy industry at University of California. Mr. Turnbow took up his new duties on February 21, 1920.

Jean Prescot Adams, director of food economics for Armour and Company, gives the following points relative to the care, preparation and use of cheese:

THE PRINCIPLES IN CHEESE COOKERY

With cheese in such prominence in the dietary of the individual, the housewife will be anxious to acquaint herself with some of the outstanding points in relation to cookery and digestion of this most important product.

When cheese is first purchased, a few minutes should be taken to properly care for it. Wrap it either in oiled paper or in a wet tea towel and store it so as to avoid any possible contamination from strong flavors or odors.

Being a ready-to-eat product, cheese in cookery is heated merely to melt it and incorporate it with the rest of the mixture. This operation does not require

high heat. And, too, being high in protein content, cheese must be cooked at a low temperature in order to attain a resulting product that will be easily digested. Therefore, in most made cheese dishes, the double boiler is employed. By this method of radiation, a cheese dish may be prepared without direct contact of high heat. If necessity demands a direct flame, the flame should be low and the time of cooking should be short.

American cheese serves many purposes. The effect of creamed cheese may be obtained by adding grated cheese to small amount of cream. Cheese may be used in desserts. Its flavor is well liked in pastries and in salads it is unsurpassed. Caution must be exercised in the adding of cheese to acid material. It is advisable in made dishes where cheese and milk are to be mixed with acid, as acetic in vinegar, to dilute the vinegar with water, and then mix it with the flour which is generally used as a thickening agent in cheese dishes.

Cheese left over may be used in extending cheese flavor in vegetable dishes, mashed potatoes or in pastries. All unused cheese, if of sufficient amount, may be coated with paraffin and stored away for future use.

Dr. E. S. Guthrie, of Cornell University, dairy department, furnishes the following news items:

Prof. H. C. Troy, who has been on sabbatic leave during the first semester of the 1919–1920 college year, has returned to his duties at Cornell. Professor Troy was collaborating in some work with Mr. Timothy Mojonnier, of Mojonnier Brothers Company, Chicago, Illinois.

Prof. F. W. Bouska of the American Creamery Butter Manufacturers' Association, visited Cornell in February, and addressed the dairy students.

Prof. Fred Rasmussen, Secretary of Agriculture of Pennsylvania, was a Farmers' Week speaker at Cornell.

The new additions to the staff at Cornell this year are: Mr. M. P. Moon, H. B. Neville, W. V. Price, L. E. Smith, and M. B. Robinson. These men were all former students and are now taking graduate work. Mr. Moon and Mr. Neville were in the sanitary corps in the army. Mr. E. Pittman, of the University of Kentucky, is also a new addition to the department of dairy industry, at Cornell, and is taking graduate work.

Prof. James D. Brew, a graduate of Cornell, later of the experiment station staff of Geneva and Illinois, and later in the employ of the Nestle's Food Company, is now assistant professor of extension teaching in the dairy department, at Cornell.

Mr. G. Clayton Dutton, for several years an extension instructor of the department of dairy industry, at Cornell, specializing in cheese, is now in commercial work in Vermont.

Mr. C. R. Owens and *Mr. L. D. Spink*, of the department of farms and markets of New York State, assisted in the instruction of the winter course in dairying.

The following extract is taken from a report of the Glass Container Association of America:

There are obvious reasons why the public want glass:

1. The fact that people can see the cream line and the contents protects them against fraud by those milk dealers who might be disposed to put a very thin or even skimmed milk into the paper container without detection.
2. The same reason enables the public to know that their milk is clean.
3. The glass bottle adapts itself readily to machinery.
4. Bacteria growth is less in glass.
5. There is no foreign taste or flavor to milk in glass bottles.
6. Milk can be iced, handled and kept more easily in glass.
7. Glass is by far the cheapest of all containers.
8. The glass bottle is the most sterile of all containers.

MINERAL MATTER AND MILK

Experiments conducted by the Bureau of Animal Industry, United States Department of Agriculture, with dairy cows are showing an important relation between milk secretion and certain mineral substances. Feeding compounds of phosphorus and calcium have resulted in a decidedly beneficial effect on the milk flow in both quantity and fat content.

It has been shown also that a deficiency of phosphorus in dairy rations has a detrimental effect on milk secretion of cows and growth of calves. A remedy was found in the addition of sodium phosphate to rations deficient in phosphorus. The work is being continued.

USE FOR WASTED WHEY

Development of a method of utilizing whey as a human food is the object of work now in progress in the Bureau of Animal Industry, United States Department of Agriculture. It is thought probable that whey represents a greater actual loss of food than skim milk—which now has become an important by-product in the dairy industry—because its feeding value is not generally recognized. Cheeses have been made from whey, but the demand for them has been limited. The use of these cheeses might be extended if their value for cooking could

be brought to the attention of housekeepers. Investigations of the use of whey solids as poultry feed also have been begun.

Considerable work has been done on the development of casein for use in waterproof glue, and a casein of low ash and acid has already been produced.

A method of producing casein from buttermilk is also being worked out. By use of a solvent to extract the fat from the buttermilk, small lots of casein have been made, and this product was found to be of general good quality and low in fat and ash, but it had the objection of dissolving slowly.

HOW FOREIGN COMPETITION AFFECTS DAIRY INDUSTRY

To meet foreign competition, dairy farmers of the United States must be able to produce a better quality of product and produce and market it more economically and more efficiently, according to specialists in the Bureau of Markets, United States Department of Agriculture.

Arrivals of shipments of Danish butter are already affecting prices on the New York city market. Argentina is producing nearly three times the amount of butter and cheese consumed, and some of the surplus may be expected to come to this country or compete with our products in foreign countries. Before the war Siberia was rapidly extending its dairy industry, and when conditions become settled in that country it may be expected to come back as a factor in the world's market. Recently there have been signs of interest in dairying in South Africa, and the industry as developed in New Zealand and Australia must be reckoned with.

If the dairy products manufactured in the United States are of a better quality than those from other countries they need not fear competition. Canada's cheese industry illustrated this. A strict system of government supervision in the training of cheese makers, in the operating of the factories, and in the grading, marketing, and exporting of the product exists there. This has tended toward an improvement in the quality of Canadian cheese until it ranks with the finest on the English markets.

The dairy industry in Argentina has grown rapidly since the beginning of the war. Before the war butter exports from that country totaled 3262 tons a year; in 1918 they were five times that. Cheese

exports were far exceeded by the imports in 1913. Now the conditions are reversed—over 6000 tons of cheese being exported in 1918.

Today most of these exports are going to European markets, but should conditions become favorable it may be expected that some of them will come to this country. The Bureau of Markets warns dairymen to be prepared to meet this competition.

This MARK OF SUPERIORITY will be found on all equipment for the

CITY MILK PLANT
ICE CREAM PLANT
and the CREAMERY

that is manufactured by

J. G. CHERRY COMPANY

These well known Dairies are using Cherry Pasteurizing equipment—all or in part:

GEO. M. OYSTER CO., Washington, D. C.
CARRY MFG. CO., Washington, D. C.
FARMERS DAIRY CO., Toronto, Canada
EDMONTON CITY DAIRY, Edmonton, Canada
POLK SANT. MILK CO., Indianapolis, Ind.
UNION DAIRY CO., St. Louis, Mo.

You will be interested in the particulars of the Cherry Method of Pasteurization. Ask us!

J.G.CHERRY COMPANY

ST. PAUL MINN. — TAMA IOWA — PEORIA, ILL
CEDAR RAPIDS
IOWA

DIRECTORY SECTION

B. JURIST, Chemical Director
Formerly with N. Y. Dept. of Health

Research Laboratories, Inc.

Consultants -- Analysts -- Sanitarians

19 Park Place, N. Y. City

Chemical and Bacteriological examinations of Dairy Products, foods and etc.

Sanitary investigations and inspections of Dairies, Creameries, Pasteurizing Plants.

Advice on all matters pertaining to the Dairy Trade.

The

Marschall Dairy Laboratory

Madison, Wisconsin

RENNET EXTRACT — CHEESE COLOR

The largest and only up-to-date factory in America devoted exclusively to the production of Pure Rennet Extract and Cheese Color.

Chr. Hansen's Laboratories, Inc.

LITTLE FALLS, N. Y.

are headquarters for the genuine and well-known CHR. HANSEN'S DANISH RENNET EXTRACT; also PEPSIN EXTRACT

CHEESE COLOR and BUTTER COLOR

LACTIC FERMENT CULTURE

BUTTERMILK TABLETS and BULGARIAN MILK CULTURE

RENNET TABLETS for Cheese Making on the farm

CHEESE COLOR TABLETS and the world-famous JUNKET PREPARATIONS

INTERNATIONAL CENTRIFUGES

INTERNATIONAL EQUIPMENT COMPANY

352 Western Ave. (Brighton)

BOSTON, MASS.

Catalog Cy. on request

Back Volumes

OF THE

Journal of Dairy Science

Vols. I and II, six issues to each volume, may be purchased:

Price, net postpaid:
$11.00, United States, Mexico, Cuba
$11.50, Canada
$12.00, other countries.

Williams and Wilkins Company

Publishers — Baltimore, U. S. A.

"Here is a book from which everyone in any way connected with the Dairy Cattle industry may learn something.—*THE FIELD ILLUSTRATED*

Feeding and Management of Dairy Cattle for Official Production

By MORRIS H. ROBERTS, Jr.

Manager of Brookwood Farms, Barryville, New York

With an Introduction by

ALFRED J. LOTKA, M.A., D.Sc.

Price, $3.75 net

Successful Method of Calf Raising
Feeding and Management of Dairy Cattle
Breeding and Developing of Pure Bred Cattle
High and Economical Dairy Production
Special References to Production of Register of Merit Records

---

The Dairy Record and Feeding Chart

By MORRIS H. ROBERTS, Jr.

Manager of Brookwood Farms, Barryville, New York

Price, $3.00 net

Indispensable as a Method of Recording

1st. Profitable and unprofitable cows in a herd.
2nd. Amount of feed for economical production.
Maximum amount, in official testing, for safe feeding to maintain a level of production.
3rd. The condition of the cow.

Invaluable to the agricultural student
Cow testing associations
Experiment stations
The individual dairyman

A four-year comparative record for 25 cows

ORDER FROM

Williams & Wilkins Company

Baltimore, Maryland

A New Contribution to Dairy Literature

"The Butter Industry"

By Prof. O. F. Hunziker

A Book of 712 Pages and over 100 Illustrations.

Prepared for the use of Creamery Buttermakers and Managers, Dairy Students and Pure Food Departments.

Special Chapters on Cream Neutralization, Pasteurization, Over Run, Moisture Control, etc.

Neutralizing Tables with Simple Directions for Preventing Over-Neutralization and Under-Neutralization.

A Valuable Book for the Small Creameryman as well as the Large Centralizer.

This Book Places before the Student of Buttermaking the Newer Knowledge of the Science and Art of Butter Manufacture.

It Brings the Investigator and Research Worker in Close Touch with the Real Problems of the Butter Industry.

It Points Out to Pure Food Officials the Possibilities and Limitations of Composition and Properties of Commercial Butter.

It deals with Scientific Truths and Practical Facts Heretofore Unavailable to the Industry.

FILL OUT ATTACHED COUPON

and mail to The Butter Industry, Sebor and Clinton Sts., Chicago, Ill. Enclose P. O. Money Order, Express Money Order, Check or Draft. The book will be sent to your address, charges prepaid, and delivery guaranteed.

Order Blank

THE BUTTER INDUSTRY,
Sebor & Clinton Sts.,
Chicago, Ill.

Gentlemen: Enclosed find $5.75 for which send Prof. Hunziker's book, postage prepaid, to

.....

.....

THE LONGER YOU DELAY USING

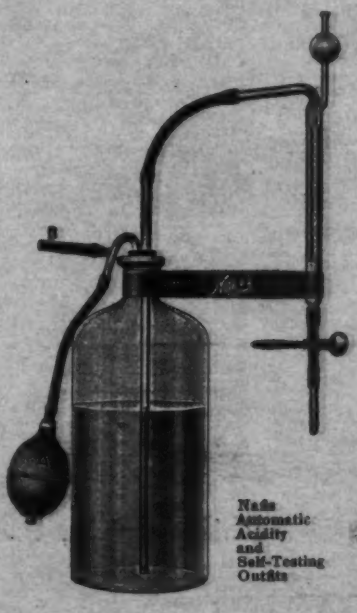
Nafis Testing Glassware

the longer you delay reaching the highest efficiency in your testing room.

Why not start now by equipping your testing room with

Nafis Scientific Glassware?

It will prove to be an INVESTMENT—not an expense. It will give you more service per dollar of cost than any other testing glassware you can buy—a fact proven by thousands of satisfied customers.



Nafis Automatic Acidity and Self-Testing Outfits

If your dealer does not stock NAFIS GLASSWARE, write for our catalog and the name of our distributor in your territory.

ACCURACY PLUS QUALITY — Nafis TRADE MARK — SAVES YOU MONEY

LOUIS F. NAFIS, Inc.

Manufacturers of Scientific Glassware

542-548 WASHINGTON BLVD., CHICAGO, U. S. A.

AS NECESSARY AS SALT

Make good butter—
Protect its goodness—
Put your brand on it—

Get your butter to the consumer as fresh, pure and clean as when it leaves your churn. Protect it from dust and dirt by wrapping it in

PATERSON PIONEER PARCHMENT PAPER

and put your name on the parchment. That will mean a bigger demand for your butter and higher prices.

Write for free book "Better Butter."
Every dairyman should read it.

The Paterson Parchment Paper Co.
37 8th Street, Passaic, N. J.

THE DAIRY LABORATORIES

20th and Market Streets, Philadelphia, Pa.

CONSULTING AND ANALYTICAL CHEMISTS

Complete Chemical and Bacteriological Analysis of Milk, Dairy Products, Foods, Water, and Medical Diagnostic Tests

Sanitary Advice and Expert Assistance **All Tests Confidential**

DR. LEE H. P. MAYNARD, Milk Expert **H. C. CAMPBELL, B.S., M.D. Ph. G., Chemist**
DR. H. S. JOHNSON, Bacteriologist **RALPH FORT, Assistant**

Branches at

WASHINGTON, D. C. **PITTSBURGH, PA.**
BALTIMORE, MD. **ST. LOUIS, MO.**